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Javanic Type Locomotive

A new type of locomotive has come into existence and has been given this designation by the builders, The Hannoversche Maschinenbau-Actien Gesellschaft, Hannover, Germany. In the numeral classification this locomotive would be a 2-12-2 tank type. It is for a 3 ft. 6 in. gage and has 43⅜ in. drivers. The four center pairs of drivers are rigid, while the first and sixth pairs are coupled on the Golsdorf system which employs flexible side rods. It is fitted with a Schmidt superheater, carries 171 lbs. boiler pressure and has a total weight of 164,500 lbs.

Earning Capacity of Freight Cars

According to a committee report presented at a meeting of the operating officials of the Illinois Central, an abstract of which was published in the October 11 issue of the *Railway Age Gazette*, the earning capacity of each freight car on that road is $2.34 a day. If Sundays, holidays and bad order cars are eliminated, the gross earning capacity of each car is about $3.85 a day and its net revenue is $1.15. The average movement of all freight cars on the Illinois Central during the busy season is 27 miles a day, which is equal to 3 hours moving in trains and 21 hours, or 87 per cent. of the time, on the sidings. It is found that a car, on an average in the busy season, is employed per month as follows: 13 days in loading and unloading; 3½ days in moving in trains, and 13½ days standing awaiting movement, switching or repairs. It is estimated that each car costs the owners 52 cents a day for interest and repairs.

Steel Passenger Cars in Service

A circular issued by the Special Committee on Relations of Railway Operation to Legislation for the purpose of ascertaining the progress of the building of steel and steel underframe passenger equipment shows that on December 31, 1911, there were 5,347 all-steel passenger cars in service on 225 railways in the United States. This is about 9.6 per cent. of the total passenger equipment on these roads; 2,399 cars or 4.3 per cent. had steel underframes. It was found that of the cars built during 1911, 59 per cent. were all-steel and 20.3 per cent. were steel underframe. Of the cars under construction at the time of the report, which numbered 1,211, 76.8 per cent. were all-steel and 16.2 per cent. were steel underframe, leaving but 7 per cent. wooden cars. The percentage of all-steel cars being built increased 750 per cent. during the 3 years from 1909 to 1912, and the indications are that the additions to this equipment from now on will be practically all either steel or steel underframe. In connection with the same report, it was found that it would cost $632,746,000 to replace the 48,126 wooden cars now in service in the United States. At 5 per cent. this amount gives an interest charge of $31,637,300 a year. At the present time there are six bills pending in Congress requiring existing wooden passenger

equipment to be replaced by all-steel and the periods suggested during which this is to be done vary from June 1, 1915, to January 1, 1918. In other words, if these bills are passed, it will compel the railway companies to spend from $100,000,000 to over $200,000,000 per year for passenger equipment.

Changes in Rules of Interchange

On September 7, 1912, there was submitted to the members of the Master Car Builders' Association a letter ballot calling for a vote on the question of abrogating the rules which penalize the delivering line for owners' defects, and also on the proposed adding of a direct percentage of 10 per cent. to the total labor and material charges as shown on monthly bills. The result of the vote on both of these proposals was heavily in the affirmative and the arbitration committee of the association has revised the rules of interchange accordingly. The Executive Committee has decided that the new rules will take effect on November 1, 1912. Changes have been made in the following rules: Nos. 4, 33, 48, 53, 55, 57, 59, 64, 95, 105, 106 and 122. Copies of the changes are now being issued by the secretary.

Locomotive Piston Speed

Several years ago a number of large freight locomotives which had small wheels and cylinders with a 32 in. stroke were put in service on one of the Eastern railways. On the same division there were consolidations which were considerably lighter in weight but had practically the same diameter of cylinders and a 28 in. stroke. The lighter engines are today handling the same tonnage trains as the much more powerful locomotives and are doing it on considerably less coal and water. This is an example of the influence of the length of stroke on the capacity of the locomotives in actual service. It is desirable to have the speed of the piston as low as possible, especially on locomotives which work at a late cut-off and, where the wheels are small, the stroke should be short if a reasonable speed is to be maintained. This feature seems to be fully considered in recent locomotive designs and will probably be given even closer attention in the future. For the benefit of designers and others who wish to determine the piston speed under different conditions, we publish on page 562 of this issue a diagram, prepared by L. R. Pomeroy, which permits a ready determination of the combination of length of stroke and diameter of drivers to give any desired piston speed at any rate of travel.

Baker Locomotive Valve Gear

The story of the article on the Baker locomotive valve gear, which appears elsewhere in this issue, is a most interesting one and will undoubtedly appeal to our readers. R. S. Mounce, the author, is of an analytical turn of mind and likes to get to the bottom of things. Moreover he has had considerable experience in the setting and the analysis of locomotive valve gears. When the Baker gear was first drawn to his attention a year or two ago he studied all of the literature available with an idea of making a careful analysis of its operation. From the data which he was able to obtain he was unable to get sufficient detail knowledge of it to enable him to analyze it thoroughly. Last June while attending the conventions at Atlantic City his attention was drawn to a model of the gear which was on exhibition there. He studied this over carefully and gained a good knowledge of its construction and working. On returning home he made a study of the action of the gear and analyzed it thoroughly. Fortunately, at just about this time the Erie applied two of these gears to locomotives at Jersey City and he was enabled to watch their application closely and follow them somewhat after they went into service. This article is a result of his investigation and study, and is undoubtedly the most simple and thorough treatment of the gear that has ever been prepared. Because of the increasing use of this gear on different roads the article will undoubtedly prove of interest and value to many of our readers.

Electric Locomotives

W. N. Storer, in a paper presented before the recent convention of the Association of Railway Electrical Engineers in Chicago, an abstract of which appears elsewhere in this issue, suggests that the great improvement in the efficiency of steam locomotives in recent years is largely due to the fact that the electric locomotive had developed to a point where it appeared to be a strong competitor for trunk line work. In some degree it is possible that this new and possibly dangerous rival spurred the steam locomotive designers to greater efforts, but it is hard to believe that practically the same progress and improvement in steam locomotives would not have taken place even had there been no such pending competition. The demands of the traffic department have been sufficient at all times to compel a continued enlargement and improvement of the locomotive and from the beginning this development has been continuous and fairly constant. It has been marked by periods of distinct changes where radical developments have been made, as for instance, the wide firebox, the Mallet type locomotive and the superheater, but between these points there has been a continual refinement and improvement of the design. It is true that in no previous decade has there been so much done in making the steam locomotive better and more efficient as in the last one, but the same was also true of the previous decade and the one preceding that. It will probably be equally true of the next. Locomotives being built today are better machines than those built last year and decidedly better than those built three years ago. While the electrical engineers are entitled to great credit for their progress and accomplishments, it is hardly fair to credit the present state of art in respect to steam locomotives to their activity. It is very doubtful if the steam locomotive of today would have been any different or any less advanced than it is, if there had never been any threatened invasion of its field.

Valve Gears on Compound Locomotives

On many of the foreign railways where the engine crews' wages depend very largely on the coal, water and oil consumption of the locomotive, it has been found advisable to install valve gears on compound locomotives so arranged that the engineman can adjust the point of cut-off in the high and low pressure cylinders independently. Usually these locomotives are also fitted with a variable exhaust nozzle. Such locomotives are generally provided with gages which give information as to temperatures and pressures at every point where the knowledge would be of any advantage in saving fuel. Under these conditions, with the incentive of higher wages, these devices are constantly being used and adjusted with most satisfactory and profitable results. In this country, refinements of this nature have been given spasmodic trials at various times, but generally without success. When the variable exhaust nozzle has been tried it has been found that it very soon corrodes and is held solidly in one position, due to not having been operated. The final result of every experiment of this kind that has been attempted in this country has been the return to the stationary nozzle. It is desirable that the amount of power developed by each of the units of a Mallet locomotive should be the same. In compound cylinders, however, this cannot be exactly true except at a single point of cut-off with a certain steam pressure. Although it does not vary greatly under normal conditions, such variations as do occur can be corrected by adjusting the point of cut-off in one of the cylinders independently of the other, and the valve gear of the 2-8-8-0 type locomotives for the Great Northern illustrated in this issue is arranged to readily permit this. Some time ago this company fitted up a locomotive with an experimental separate cut-off arrangement on the two pairs of

cylinders and made tests to ascertain how the work was divided by the two groups of wheels when the engine was operating at different speeds on different grades. It was found that when a constant pressure was maintained in the receiver pipe the division of the work was more nearly equal. The best receiver pipe pressure for the experimental engine was found to be 60 lbs. and instructions were issued to operate the locomotive so that the gage for the receiver pipe would show this pressure at all times. In regular service this worked out very satisfactorily when operating on rolling grades, but of course when the engines were working on hills there was no occasion for varying the cut-off. The new locomotives will be subjected to tests to determine what receiver pipe pressure will be necessary in order to properly equalize the work, and instructions will be issued to enginemen on these locomotives to maintain this pressure on the receiver gage at all times.

Shop Practice and the Small Shop

The best method of doing any particular work in one shop may be altogether wrong or impossible in another. This is partially due to the difference in machine tools that are available in the two cases and partially to the different designs of the same parts on different roads or on different locomotives. How much this may affect the time required for the work is well illustrated by the articles on repairs to pistons, piston rods and crossheads, which appeared on page 523 of the October issue, and the same work as described by Mr. Black on page 559 of this issue. In the former cases, both of which are descriptions of methods used in large modern, thoroughly equipped shops, the total time for doing the work was twelve hours and twenty-nine minutes, and sixteen hours and forty-three minutes, respectively, while in the smaller shop, with its lack of special tools and of special arrangements for this particular work, it requires twenty-four hours and fifty minutes. We publish Mr. Black's description as an example of what can be done under adverse conditions. For instance, it will be seen that there is no radial drill available for drilling and tapping the staybolt holes in the piston head, and no piston rod grinder or vertical turret lathe, any one of which would have made a decided difference in the time of doing the work. Furthermore, he is handicapped, compared with some other shops, by having a piston head requiring staybolts, as well as in the design of the crosshead.

While each shop must adopt methods that are suited to its own conditions, it should not be assumed that because work has been done in a certain way in the past, this is the best way for it to be done now. It is seldom that an outside expert cannot go in a shop and point out ways of improving many of the practices of machining parts, even those which are handled in large quantities. This is more often due to his knowledge of how the same work is being done in other places and his adaptation of the better methods to the local conditions. It is with this object in mind that the shop practice articles have been printed in these columns. While probably no method described could be adopted without change in another shop, the ideas which governed the originator of the methods can be adapted to any shop, often with decided improvement.

Reducing Smoke from Locomotives

While it is desirable to reduce the smoke emission of all locomotives as far as practicable, it is the switch engines, working in thickly settled districts, that should receive the closest attention. The Lake Shore & Michigan Southern has been most successful in its efforts to reduce smoke from this source, and D. R. McBain, superintendent of motive power, explained the methods by which this had been accomplished to the National Association for the Prevention of Smoke at its recent Indianapolis, Ind., meeting. A liberal extract of his address is given elsewhere in this issue. So far as the construction of the locomotive itself is concerned, there are three features that have been found of primary importance. The first and greatest is probably the superheater, which in itself in no way affects the efficiency of the combustion in the firebox, but from the fact that its presence reduces the amount of coal consumed on a switch engine by a very large amount—40 per cent. being reported in some cases—the smoke emitted, independent of other factors, is reduced in the same proportion. In this connection, however, the fact that less coal is required and that the steam pressure is maintained much more easily, permits the fireman to give closer attention to his method of firing; or, in other words, it is made possible for him to do what Jim Skeever's fireman found impossible, i. e., to fire for smoke instead of steam. In this way the superheater has a still further effect on the amount of smoke.

The next feature mentioned by Mr. McBain is a brick arch which is conceded to be the most important agency for improved combustion that can be applied to the locomotive. The arch in the switch engines on the Lake Shore is larger and covers a greater area than the customary arrangement used on road engines. It is so designed that the strong exhaust will have little effect on the fuel bed, and a considerably thinner fire can be carried. It forces a most thorough mixture of the gases and gives them ample time for complete combustion before entering the flues. As a further adjunct, steam jets on either side of the firebox just above the fuel bed are recommended. These jets assist in mixing the products of combustion and inject a further supply of oxygen above the fuel bed.

These three appliances, when combined with the proper maintenance of the locomotive as a whole, have practically eliminated the smoke emission from switch engines, and at the same time have given a large reduction in the coal and water consumption. In a busy yard this increased efficiency is of more importance than simply the saving in the cost of the fuel, as it reduces the necessity of the engines frequently leaving their work to obtain renewed supplies—particularly of water. The new arrangement is also favored on the locomotives which work around and through passenger stations because of the absence of dirty water and cinders thrown from the stack. Claims for damage to wearing apparel from this source will often amount to a very considerable sum in the course of a year.

NEW BOOKS

Light, Its Use and Misuse. Bound in paper, 20 pages, 6 in. x 9 in. Illustrated. Published by The Illuminating Engineering Society, 29 West Thirty-ninth street, New York. Copies free.

This pamphlet has been prepared to furnish the public with information on the general principles of light and illumination. The illustrations are particularly good and present to the reader in an impressive way the difference between good and bad illumination with the same amount of light. The pamphlet, in itself, is an object lesson and is printed on dull finished paper with ink that is free from reflection. The text matter throughout is interesting.

Applied Methods of Scientific Management. By Frederick A. Parkhurst. Illustrated. Bound in cloth, 320 pages, 6 in. x 9 in. Published by John Wiley & Sons, 43 East 19th street, New York. Price $2.00.

A series of articles under the above title, written by Mr. Parkhurst, appeared in *Industrial Engineering* during 1911. These have been collected and amplified, and now appear in book form. The actual detailed application of the methods of scientific management to a comparatively small manufacturing plant is given, and the processes of installation and the results are illustrated by statistics obtained from actual records. The

manufacturing company referred to is the Ferracute Machine Company, makers of presses and dies at Bridgeton, N. J., which normally employs about one hundred men. The net result of the application of the new methods was a large increase in the output with a decided decrease in the unit labor cost. How and why this was accomplished is fully explained.

Railway Storekeepers' Association. Proceedings of the ninth annual meeting. Illustrated. Bound in cloth, 217 pages, 6 in. x 9 in. Published by the Railway Storekeepers' Association, J. P. Murphy, Secretary, Box C, Collinwood, Ohio.

At the ninth annual convention of the Railway Storkeepers' Association, held in Buffalo, N. Y., May 20 to 22, a number of important subjects were brought up for discussion and action. Among these were reclaiming of scrap material and line inspection. The standardization of both tinware and grain doors was discussed, as well as the uniform grading and inspection of lumber, methods of accounting, preparing packages for shipment, and increasing the efficiency of the department as a whole. The proceedings includes a list of the members of the association, the committees for the coming year and a copy of the constitution and by-laws.

Proceedings of the Western Railway Club—1911-1912. Illustrated. Bound in cloth, 266 pages, 6 in. x 9 in. Published by the Western Railway Club, J. W. Taylor, Secretary, 390 Old Colony Bldg., Chicago. Price $2.00.

For many years the Western Railway Club has held a prominent place among the railway clubs, and an examination of this volume of proceedings for the year ending last June, indicates that the members propose to see that it maintains its present standing. There were nine papers presented for discussion, as follows: Some Experiments with Car Trucks; Oxy-Acetylene Welding; Use of Denatured Alcohol in Railway Service; Terminal Brake Testing; Head-end Electric Train Lighting; Steel Wheels; Locomotive Valve and Cylinder Lubrication; Revision of the Rules of Interchange and Water Treatment and Boiler Troubles. The complete verbatim discussions accompany the papers, and lists of the members attending the meetings, as well as the new members for the year, are given. The volume is well indexed.

American Machinist's Grinding Book. By F. H. Colvin and F. A. Stanley. Illustrated. Bound in cloth, 376 pages, 6 in. x 9 in. Published by the McGraw-Hill Book Co., 239 West 39th street, New York. Price $3.00.

The purpose of the authors in bringing out this volume is well described in the preface as follows: "The grinding machine in its various forms and the numerous grinding processes has assumed a place of such importance in the manufacture of machinery and the finishing of metal parts in general, that it has been considered desirable to bring together in the form of a reference book, such data on these machines, wheels and methods, as are likely to be of interest and service to grinder purchasers and operators, and to the men responsible for results in the grinding department." The book is most complete and thorough. It has nineteen chapters and contains 286 illustrations and 36 tables. The last chapter is entitled, "Helps and Suggestions," and gives information on all features of interest to the operator. The proper kind of wheels to be used on different classes of work is given and tables are included, giving the best shapes for grinding all classes of tools.

The Coking of Coal at Low Temperatures, with a Preliminary Study of the By-Products. By S. W. Parr and H. L. Olin. Bulletin No. 60 of the Engineering Experiment Station of the University of Illinois. Copies may be obtained upon application to W. F. M. Goss, director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

The studies give the details of a large number of experiments on the low temperature distillation of coal not exceeding approximately 750 deg. F. Certain fundamental principles have been developed which underlie the coking of coals of the Illinois type. A striking illustration is given of the fact that even a small amount of oxidation of the coal diminishes or destroys its coking power. Superheated steam was used to remove all traces of an oxidizing atmosphere. Freshly mined coal was found to be essential in the experiments. The by-products consist of illuminants of high candle power, of tarry material which consists in the main of oils, and a coke which has a composition somewhat similar to that of the so-called smokeless coals. The nitrogen recovery is small, not exceeding 5 per cent. of that material present in the coal. The results seem to justify the conclusion that a fuel can be produced suitable for use in domestic appliances, as well as under industrial conditions, and that the theoretical principles developed point to the possibility of making a good type of coke from Illinois coals.

Modern Organization. By Charles De Lano Hine. Bound in cloth, 110 pages, 4¾ in. x 7¼ in. Published by the Engineering Magazine Company, 140 Nassau street, New York. Price $2.00.

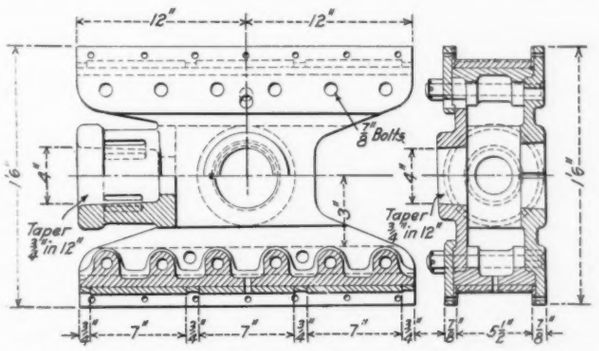
About four years ago, the first installation of Major Hine's unit system of organization was made on the Nebraska division of the Union Pacific. During the following three years it was continually extended until it covered twenty-seven operating divisions and six general operating jurisdictions. While it would be impossible to make any changes on a railroad, especially one so fundamental as the change in the system of organization, without causing some confusion, it is considered very surprising by those who have been in a position to know all the facts, how little confusion has resulted in this case. This feature alone has done much to prove the soundness of the principles involved. That it has promoted efficiency in practically every direction is acknowledged. It has been more successful on some divisions than on others, and where the application of the principles has been the most consistent and earnest, the corresponding benefits have been the greatest, but in no case has there been any evidence of any loss of efficiency under the new system. A series of articles by Major Hine in the *Engineering Magazine*, descriptive of this new system, which ran from January to July, 1912, have been published in book form and form a comprehensive definition of the author's philosophy of management and an explanation in some detail of the manner of putting it in effect. Major Hine states in one place that, "Organization is a necessity and not an accident. Organization exists in response to some need of the social order. The type of organization adopted, however, is often accidental and frequently unscientific. There are so many more men who know how than there are who know why, that departures from sound principle should be expected rather than otherwise." The fundamental principles of the system of organization described are those of correcting over-specialization and over-standardization by simple changes of official relation and departmental routine. No elaborate system is introduced, but, on the contrary, the whole operation of the department is simplified. There are no changes made affecting the rank and file, but that most objectionable practice commonly known as "government by chief clerks" is entirely eliminated. The changes in official status are generally in the direction of a broadened authority and opportunity. The reasons for the often expensive differences between the line and staff are explained in one of the chapters, and the manner in which this system of organization makes impossible such a clash of authority or professional friction, is explained. The book is most interesting and is complete in its general description. There arise, however, in the reader's mind many questions in regard to details which are not clearly explained, such as, for instance, the arrangement when the master mechanic's office may be a considerable distance from the superintendent's headquarters, the handling of emergencies in one department by a man whose training and experience have been altogether in another line, the unequal rates of pay for men carrying the same title, etc.

PISTON, PISTON ROD AND CROSSHEAD REPAIRS.

Showing What Can Be Done in the Smaller Shops Without Special Tools or Facilities for the Work.

BY GEORGE BLACK,
Canadian Pacific, West Toronto, Canada.

The best method for handling this work will vary at different places, depending on the equipment available, and what might be an excellent method in one shop would not be at all correct at another. While the operations will, in general, be the same in the large as in a small shop, the quantity of work done in the former will justify the devoting of a certain number of machine tools entirely to this class of work, as well as the purchase of tools especially fitted for this work, while in the small shop the work has to be done on machines that are also used for other repairs. In the small shop, therefore, the most that can be done is to arrange the available machinery



Type of Crosshead to Which the Operations Described Are Applicable.

on a compromise basis so that it will be equally well suited for the various more important operations. In the following discussion the reader should understand that the methods are those which are believed to be the best possible for a small shop without special tools for this class of work.

The first operation consists of removing the front cylinder head and its casing, disconnecting the crosshead, and removing the piston head and its rod from the cylinder to the floor. This operation, including the dropping of the main rod requires 57 min., which is divided as follows:

Remove front cylinder casing and head	20 min.
Remove wrist pin and drop main rod	12 min.
Disconnect piston rod from crosshead	15 min.
Remove crosshead, piston, packing and gland	10 min.
Total	57 min.

CROSSHEAD REPAIRS.

One of the illustrations shows the type of crosshead that is to be repaired. It is refitted at a bench near the engine in the erecting shop. To thoroughly refit it means the renewing of six sectional liners and four side liners. To do this it is necessary to remove twelve 7/8 in. bolts and twenty-eight copper rivets along the side liners. This operation usually requires about 60 minutes.

An examination of the crosshead and cast steel shoes is next made. The former is inspected for defects around the throat and key slot, and the latter for wear on the retaining bars, due to the sectional liners becoming loose and floating back and forth. It is quite possible that the retaining bars may already have been calked up in an endeavor to hold the liners tight. If they are worn or otherwise broken so that they are not standard, it is our custom to reclaim the shoes by building up the worn or broken places with the oxy-acetylene apparatus. A very badly worn shoe can be built up again and made equal to a new one at an expenditure of seventy cents for oxygen, carbide and soft wire. The time required to do this would be about 50 minutes, and an apprentice boy can easily shape out the liner fits in 90 minutes, again making the shoe standard in every particular.

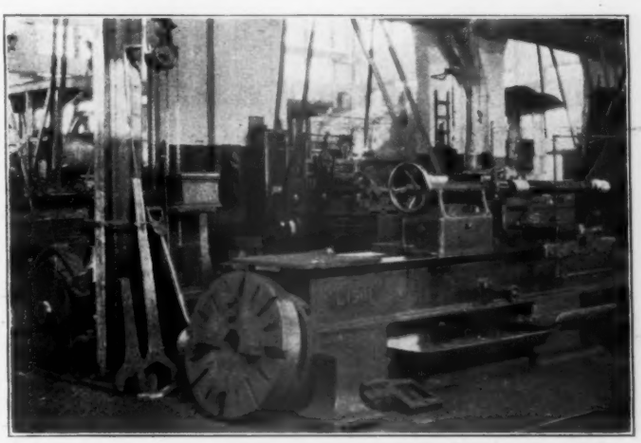
Side liners are carried in stock already machined, and the fitting and laying off of four liners ready for drilling and counter-sinking will require 15 minutes. They are drilled and counter-sunk in 21 minutes. A speed of 350 r. p. m. is used on the hand feed for drilling 15/32 in. holes and a speed of 300 r. p. m. is used for countersinking. Detailed times of the operation are as follows:

Prepare machine and set work	3 min.
Drill 28 15/32 in. holes	8 min.
Change tool and speed and countersink 28 holes	8 min.
Remove work and clear machine	2 min.

The liners are then returned to the fitter and applied to the side plate and crosshead. They are held by 3/8 in. copper rivets. The fitting, riveting and finishing of the job complete will require 60 minutes for the four liners.

The sectional liners are also carried in stock, machined to size and the fitting and applying of six of them requires 30 minutes. After they are in place the side plates and bolts are applied, nuts put on and split keys inserted. This work will consume 60 minutes more.

The complete operation of repairing this type of crosshead



View Showing the Clamp for Holding Piston Heads, and the Lathe for Finishing Rods.

as described will thus consume a total of 386 minutes as follows:

Removing side plates and side liners	60 min.
Reclaiming shoes	140 min.
Fitting and drilling four side liners	36 min.
Applying side liners	60 min.
Fitting and applying six sectional liners	30 min.
Assembling and bolting up	60 min.
Total	386 min.

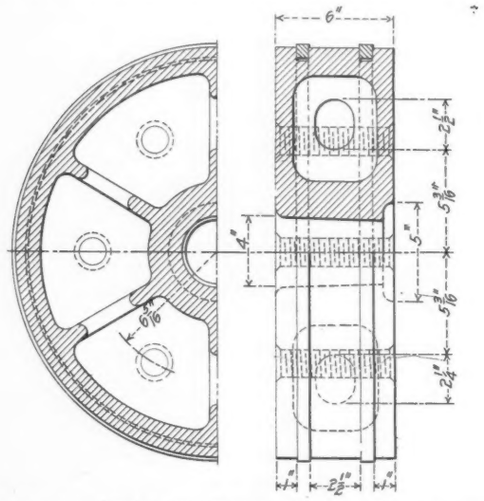
BORING THE CYLINDER.

If the cylinder needs reboring, a three year erecting shop apprentice removes the back cylinder head, cleans the counter-

bore and sets up the boring bar. The boring bar used at these shops is the Underwood, manufactured by H. B. Underwood & Co., Philadelphia. The machinist checks the setting of the bar and the apprentice then proceeds to take the necessary cuts, being careful to leave a witness mark. An air motor drives the boring bar at a speed of 4 r. p. m., and the roughing cut will carry a feed of 3/32 in. per revolution. While, of course, the time will vary with the condition of the cylinder and the number of cuts necessary, the average time for this work will be from 10 to 12 hours.

PISTON ROD.

The first operation of separating the piston rod and head consists of removing the pin through the nut. If this can be taken out by hand the operation requires from 5 to 15 minutes. However, not infrequently it is necessary to drill out this pin, and in that case the piston head and its rod are taken to a drill press and a long forged drill is used in order to clear the head. It will require on an average of about 40 min. to take out the pin by this method. This includes the transfer of the parts and the cleaning of the machine. The head and rod are then returned to a special vise which clamps the head and permits the removal of the nut by means of a long wrench. This operation will require about 32 minutes. The head and



Piston Head to Which the Times Given for Repairs Apply.

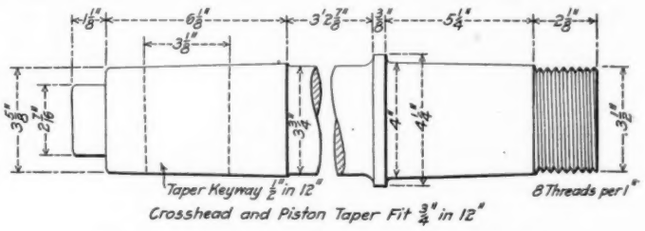
rod are then taken to the regular wheel press and separated. This operation requires 20 minutes, which includes preparing the press and removing the rod and head after being separated.

Before removal from the head, if the rod is not too badly worn, the crosshead fit is painted with a mixture of white lead and lard oil, and given a sledge hammer test for flaws around the keyhole. If defects appear, the rod is scrapped or made into a shorter rod for a smaller engine. If there are no defects it will be trued up and used again. It is the practice at this shop to keep three or four piston rods and heads on hand in a semi-finished condition, which in the case of the rods would include complete machining except the two fits.

With a new rod, the first operation will be centering both ends and cutting to length. This work is done on a lathe manufactured by Dean, Smith & Grace, of England, which swings 30 in. over the bed and is very powerful. The total time for centering and cutting off the new rod is 59 minutes. The detailed operations are shown in the following table:

Prepare the machine, mark centers and chuck the rod	15 min.
Drill center	5 min.
Face the end	4 min.
Countersink center	4 min.
Reset rod and mark for length	6 min.
Drill center	8 min.
Change tool and face end to length	8 min.
Countersink center	4 min.
Remove rod and clear machine	5 min.

The time required for turning the rod, including making the fit at the crosshead end will be 184 minutes, of which rough and finish turning of the body requires 121 minutes and the finishing and filing of the crosshead fit consumes 63 minutes. Making the piston head fit is a similar operation and will require the same time of 63 minutes. Threading the rod and fitting the nut will take 30 minutes more. After the crosshead fit is completed and before the rod is finally taken out of the crosshead, the key slot is scribed. It is then transferred to a drill where a jig, shown in one of the illustrations, is used to give the correct angle to the slot. Four ⅝ in. holes are drilled



Piston Rod to Which the Operations Specified Apply.

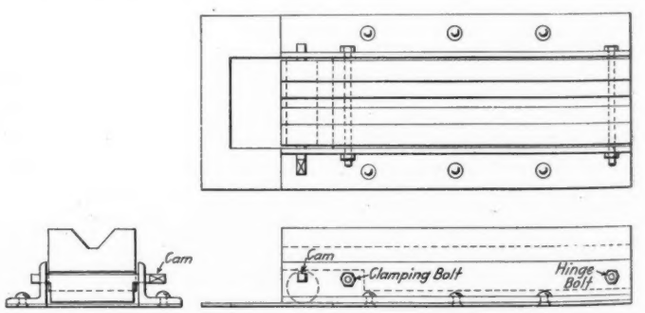
through the rod. This requires 52 minutes, including the preparation of the machine, setting of the chuck, installation and removing of the jig, etc. From the drill the rod passes to the milling machine where it is clamped in V blocks and an end mill breaks in the four ⅝ in. holes. A spiral mill then finishes the slots to width. This operation requires 91 minutes, the detailed operation being as follows:

Prepare machine and set V blocks	15 min.
Set mill and rough out slot	32 min.
Change tool and finish mill slot	34 min.
Remove rod and clear machine	10 min.

If a new key is required a tin template is made from which the blacksmith forges a key and punches a cotter pin hole. Forging the key will take 60 minutes, and filing and fitting it in the rod and crosshead will require 60 minutes more.

The total time for finishing the rod complete is 479 minutes, divided as follows:

Centering and cutting to length	59 min.
Rough turning fits and finish turning rod	121 min.
Finish and fit crosshead end	63 min.
Finish and fit piston end	63 min.
Threading and fitting nut	30 min.
Drilling and milling keyway	143 min.
Total	479 min.



Jig for Drilling Key Slot in Piston Rods.

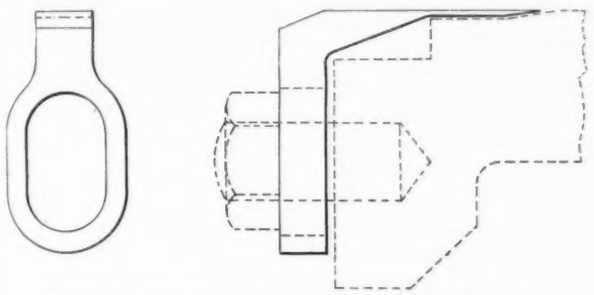
For facilitating the operation of separating the crosshead and the piston rod during the time the fits are being made a dummy wrist pin and taper drift are used. This arrangement is shown in one of the illustrations.

PISTON HEAD.

At this shop the turning of the piston head is performed in two operations, viz., rough and finish turning. The head to which these times apply is shown in one of the illustrations

The rough turning requires 156 minutes, detailed as is shown in the following table:

Operation	R. P. M.	Feed.	Cut.	Time.
Prepare machine, chuck and true up piston	..	.....	.....	15 min.
Set tool and cut	..	.....	.....	2 min.
Face piston	10	⅛ in.	3/16 in.	15 min.
Change tool and speed	..	.....	.....	2 min.
Rough bore (3 cuts)	33	1/16 in.	⅛ in.	15 min.
Change tool and speed	..	.....	.....	2 min.
Turn outside diam. (2 cuts)	10	⅛ in.	3/16 in.	18 min.
Change tool and set cut	..	.....	.....	2 min.
Rough grooves (2)	10	H.†	¾ in. x 1 in.	30 min.
Change tool and speed	..	.....	.....	2 min.

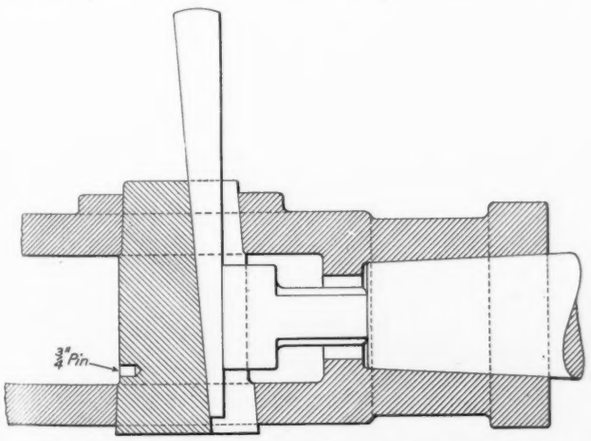


Guide for Entering Piston Packing in the Cylinder.

Recess for nut	25	H.	¼ in.	8 min.
Remove tool, reset and true up head	..	.....	.....	12 min.
Change speed, set tool and cut	..	.....	.....	3 min.
Turn outside diameter	10	⅛ in.	3/16 in.	5 min.
Change tool and face piston	10	⅛ in.	⅛ in.	15 min.
Remove tool and piston, clear machine	..	.....	.....	10 min.
				156 min.

The finished turning of the head consumes 98.5 minutes, as is shown in the following table:

Operation.	R. P. M.	Feed.	Cut.	Time.
Prepare machine, chuck and true up head	..	.....	.....	15 min.
Set tool and cut	..	.....	.....	2 min.
Finish turn outside diameter	10	1/16 in.	1/16 in.	5 min.
Change tool, radius edge	10	H.	H.	2.5 min.
Change tool, finish turning grooves to gage (2)	10	1/64 in.	H.	10 min.
Change tool and speed	..	.....	.....	2 min.
Finish turning recess for nut	25	H.	1/16 in.	5 min.
Reset and true up head	..	.....	.....	12 min.
Change tool and speed. Set top rest taper	..	.....	.....	5 min.



Wedge for Separating the Piston Rod and Crosshead.

Bore rod fit taper	33	H.	⅛ in.	8 min.
Change tool and speed	..	.....	.....	2 min.
Ream rod fit (standard)*	22	H.	⅛ in.	10 min.
Change tool and speed	..	.....	.....	2 min.
Radius edge rod fit	33	H.	⅛ in.	1 min.
Change tool and speed	..	.....	.....	2 min.
Finish turn outside diameter	10	1/16 in.	1/16 in.	3 min.
Change tool and radius edge	10	H.	1/16 in.	2 min.
Remove and clear machine	..	.....	.....	10 min.
Total				98.5 min.

* A flat reamer is used with hard wood blocks to steady it.

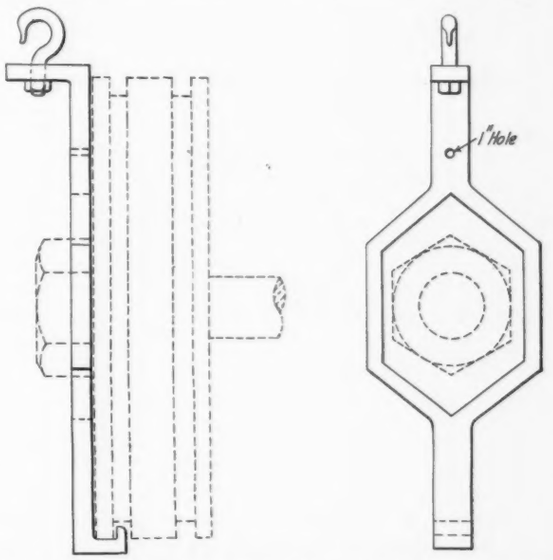
† H indicates feed by hand.

It will be noted that there are six staybolts through this head. It is removed from the lathe and taken to the drill press. The drilling and tapping of the holes requires 84 minutes. The drill used is not of the radial type and it is necessary to reset the work for each hole. This is an example of the handicap a small shop is compelled to undergo, which accounts for the seemingly excessive time required for some of this work. The staybolts are threaded in a double head Acme machine and are applied to the piston head, cut off and riveted over on either side. This operation requires 47 minutes.

The head is now pressed on the rod and then clamped in the special vise shown in one of the illustrations to have the nut applied and drawn up. The time required for performing this operation is 47 minutes. It is then taken to the drill press and a pin hole drilled through the nut and rod, and a one-half inch pin applied. This takes 40 minutes.

The total time for finishing a new piston head complete and applying it to the rod is thus seen to be 482.5 minutes, divided as follows:

Rough turning piston head	156	min.
Finish turning piston head	98.5	min.
Drilling and tapping holes for staybolts	84	min.
Applying staybolts	47	min.



Jig for Lifting Pistons and Rods, Also Used for Cylinder Heads.

Pressing on head and applying nut	57	min.
Drilling hole and applying pin	40	min.
Total	482.5	min.

PISTON PACKING RINGS.

The packing rings are all machined to gage and are cut from the customary form of cylindrical casting provided with lugs on one end for clamping to the faceplate of the boring mill. A 60 in. boring mill is used on this work and the time for boring, turning and parting the rings is 22 minutes each. The detailed operations are shown in the following table:

Prepare machine, set and clamp casting	15 min.
Set tool and cut	2 min.
Face top of casting	2 min.
Change and set tools and cut	3 min.
Bore inside and turn outside of casting	30 min.
Change tool and set cut	2 min.
Finish turning outside of casting	9 min.
Change and set tools and cut	4 min.
Part off ten ¾-in. rings to gage	150 min.
Remove base of casting and clear machine	8 min.

The rings are first cut in two and then applied to the cylinder and the amount of lap is marked. This extra end is then cut off and the ends squared up with a file. The time for fitting two rings in this manner will be 50 minutes, which includes applying them to the piston head.

For putting the piston and rod in the cylinder after the rings are in place, a form of finger has been designed for guiding the packing as the piston enters, and is shown in one of the illus-

trations. Four of these are used and eliminate the trouble of the rings striking the shoulder.

In this connection an attachment for lifting the head into place has been designed. This is also shown in one of the illustrations. It simply hooks in one of the packing ring slots at the bottom and slips over the nut and thus does not require any direct fastening to keep it in place. This device is also used in applying the front cylinder heads, a one inch hole being drilled in the lifter through which the casing stud enters and the head is held by a nut.

The whole operation of applying the piston to the cylinder, connecting up the crosshead, applying the piston and rod packing, putting up the head and casing and marking the striking points requires 121 minutes divided as follows:

Oil and apply the piston to cylinder	15 min.
Apply gland and packing and couple up to crosshead	38 min.
Put up cylinder head and casing	60 min.
Mark striking points	8 min.
Total	121 min.

The complete time for repairing the piston head and crosshead, including removal and application to the locomotive is thus seen to take 1,490 minutes, divided as follows:

Repairing crosshead	386 min.
Making new piston rod complete	479 min.
Making new piston head, complete	482 min.
Making and applying two packing rings	22 min.
Applying to locomotive	121 min.
Total	1,490 min.

Motor Omnibuses for London.—In order to meet the enormous increase of traffic in London, the Metropolitan Electric Tramways Company has ordered 300 motor omnibuses which have double decks.

DIAGRAM FOR PISTON SPEEDS

By L. R. POMEROY.*

The piston speed of a locomotive is a function of the rate of travel over the track, the diameter of the drivers and the length of the stroke, and when the travel is expressed in miles per hour and the other two factors in inches, the piston speed, in feet per minute, can be expressed by the following formula in which P equals piston speed; M, miles per hour; S, stroke and D, diameter of drivers.

$$P = \frac{56MS}{D}$$

While this is a simple formula for calculation, most designers and computers prefer to use the graphical form and the diagram shown herewith is arranged to give piston speeds accurately for train speeds between 15 and 85 miles per hour and for various strokes from 22 in. to 36 in. and driving wheel diameters from 50 in. to 84 in. In using the diagram, it is entered from the left hand side on the scale of train speeds and the horizontal line is followed until the stroke desired is reached. A vertical line is then followed to the intersection of the proper diameter of drivers and then horizontally to the scale on the right hand side where the resulting piston speed can be found. Two examples, one at 80 miles per hour, 24 in. stroke and 84 in. drivers, and the other at 35 miles per hour, 26 in. stroke and 72 in. drivers are shown by the dotted lines.

It is also possible to use the diagram for obtaining any of the four variables when the other three are known.

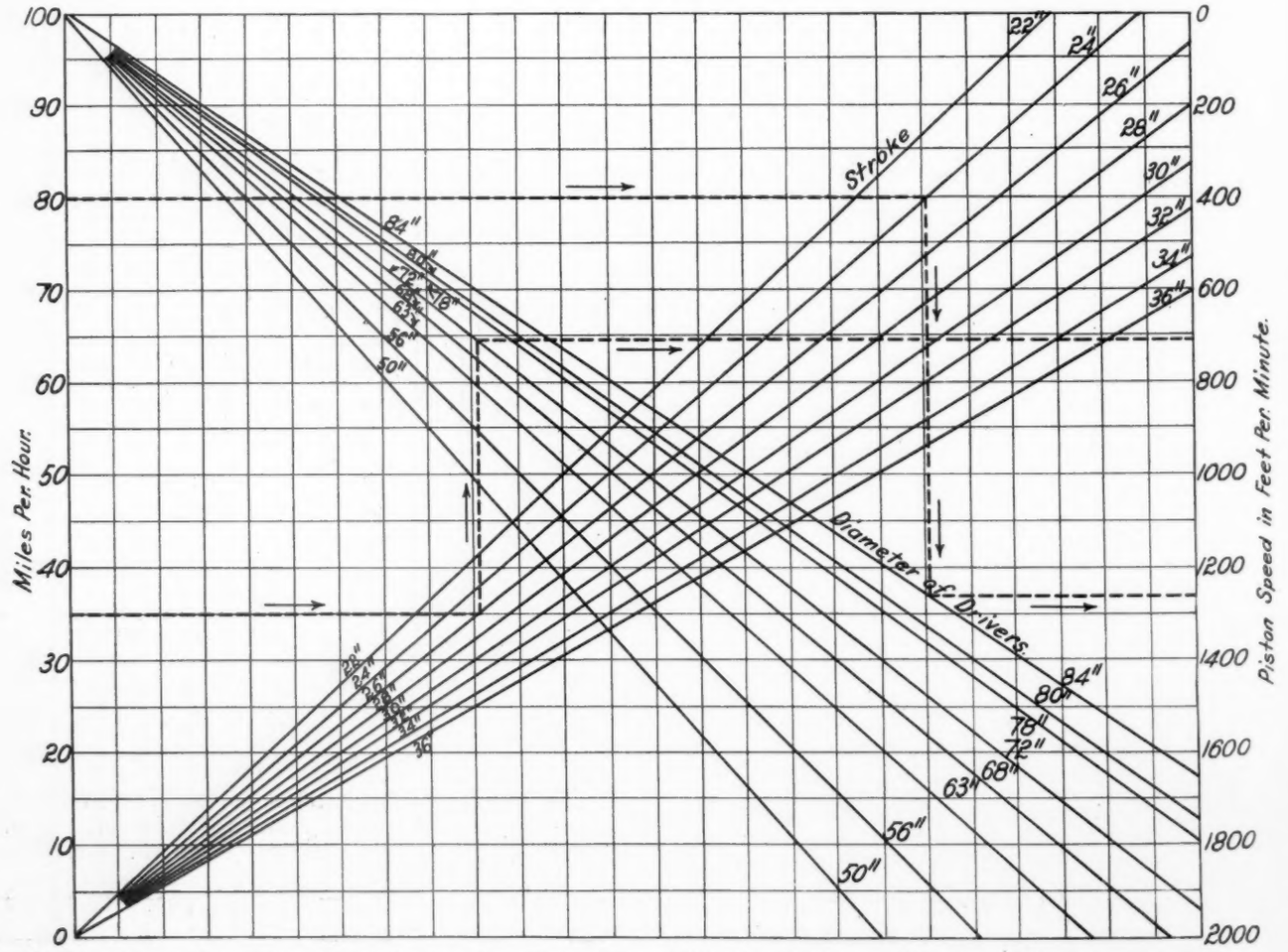


Diagram for Obtaining Piston Speeds for Any Given Rate of Travel When the Stroke and Diameter of Drivers Are Known.

* Consulting Engineer, 105 West Fortieth Street, New York.

LARGE MIKADOS FOR THE ROCK ISLAND

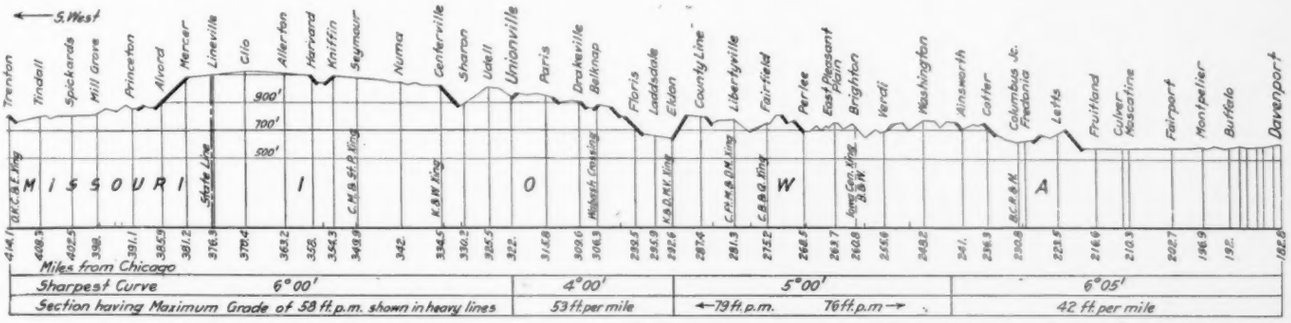
A 45 Per Cent. Increase in Tonnage With the Same Fuel Consumption as Compared With Consolidations.

Fifty locomotives of the 2-8-2 type have recently been put in service on the Chicago, Rock Island & Pacific, and are proving most satisfactory from the standpoint of economy, in one case hauling trains of 45 per cent. greater tonnage than the consolidations previously in use, with approximately the same fuel consumption. Forty of these locomotives were built by the Baldwin Locomotive Works and ten by the American Locomotive Company. The accompanying photograph shows the Baldwin engines and the drawings are for those built by the American Locomotive Company. There is practically no difference in the two designs except in the boiler, where the Baldwin engines have four more 2¼ in. tubes. This and the difference in details effect the weights as shown below.

In general the design is similar to the engines built for the Erie about a year ago.* There are two important differences in the design, however, one being the length of the stroke, which is 30 in. on the Rock Island and 32 in. on the Erie, and the other the smaller grate area of 63 ft. on the Rock Island as compared with 70 ft. on the Erie. The steam pressure on the Rock Island engine is 180 lbs., which offsets the shorter stroke and gives these locomotives practically the same tractive effort as the Erie design. The smaller grate area was specified on the basis of the experience with the Erie engines. Both designs have superheaters and brick arches, the latter being supported on four 3 in. water tubes.

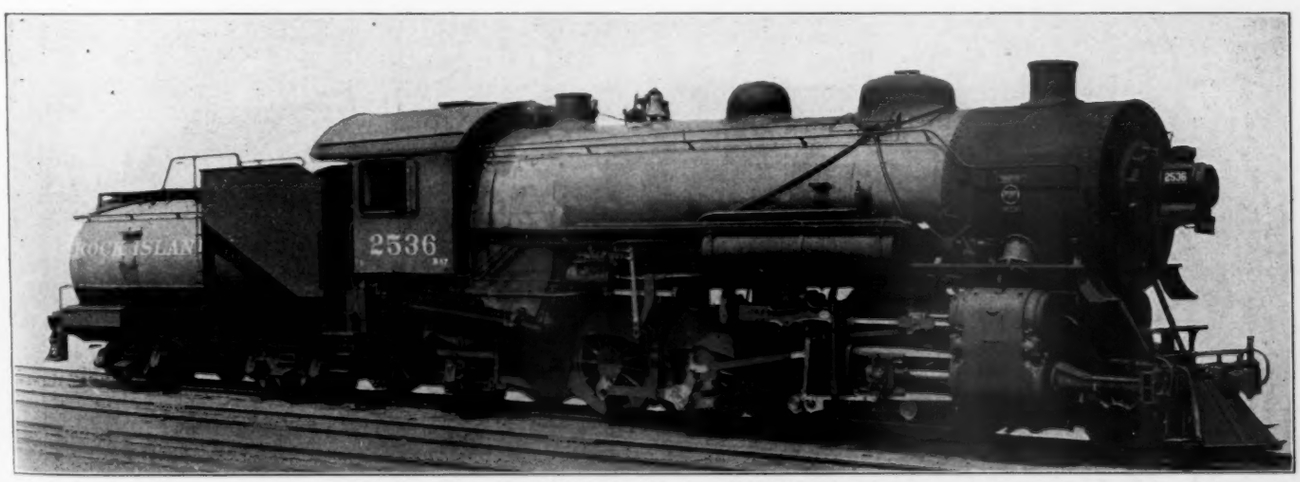
*See *American Engineer*, February, 1912, page 87.

These locomotives are now operating on the Iowa, Missouri, Kansas and El Paso divisions. On the last division between Herington and Pratt, Kans., a distance of 126 miles with numerous grades of 42 ft. to the mile, the Mikados are handling trains of 2,400 tons and burn about 10 tons of coal. Consolidation locomotives having 23 in. x 30 in. cylinders, 185 lbs. of steam, and a tractive effort of 39,612 lbs., which had previously been in service at this point, hauled trains of 1,650 tons and burned the same amount of coal. The consolidation locomotives are not equipped with superheaters and have 336 2 in. flues, 15 ft. 6 in. long, giving a heating surface of 2,710 sq. ft., a grate area of 50.2 sq. ft., firebox heating surface of 168 sq. ft., and a total weight of 213,000 lbs.

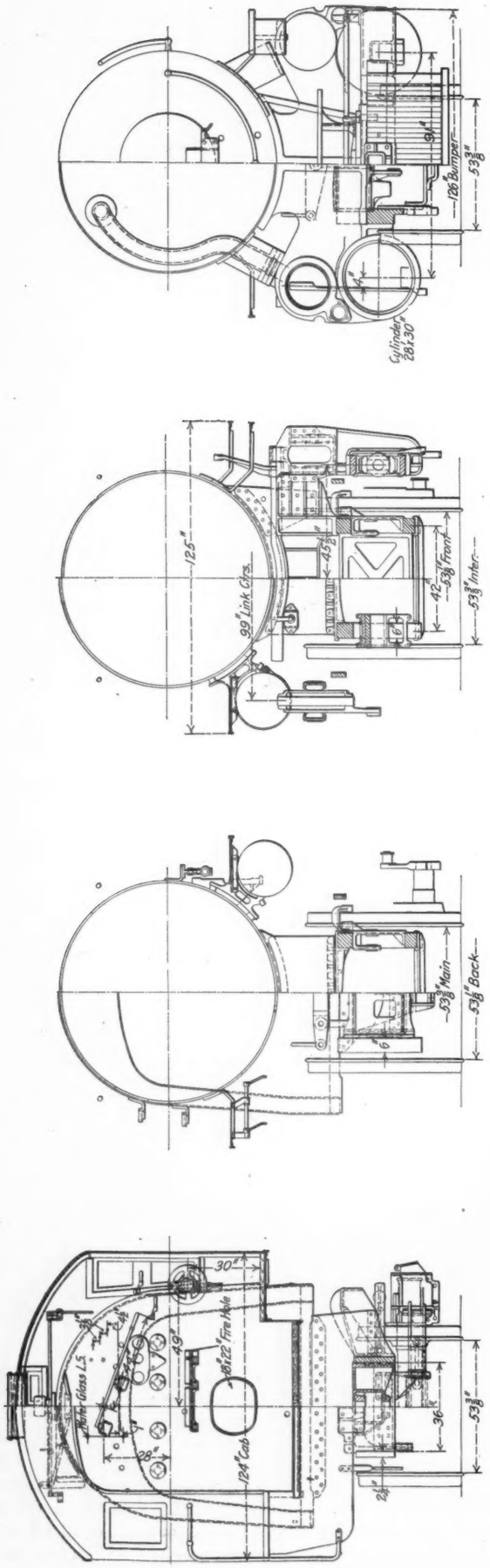


Profile of the Rock Island Between Davenport, Iowa, and Trenton, Mo., Where the 2-8-2 Type Locomotives Are in Service.

On the Missouri division, where the largest number of Mikados are now in service, they handle trains of 1,780 adjusted tons from Silvis (Davenport) to Eldon, Ia., and from Eldon, Ia., to Trenton, Mo., about 121 miles, they handle 2,200 adjusted tons. In the same two districts consolidations handle 1,250 and 1,550 adjusted tons. Eastbound, the tonnage for the Mikados is 2,100 adjusted tons from Trenton to Eldon and 1,620 adjusted tons from Eldon to Silvis; for the consolidations it is 1,480 and 1,140 adjusted tons, respectively. The car factor of this territory is 6. The grades and curvature of these two districts are shown in the illustrations. A study of the design shows that while there have been incorporated all of the improvements which have proved successful in service, nothing



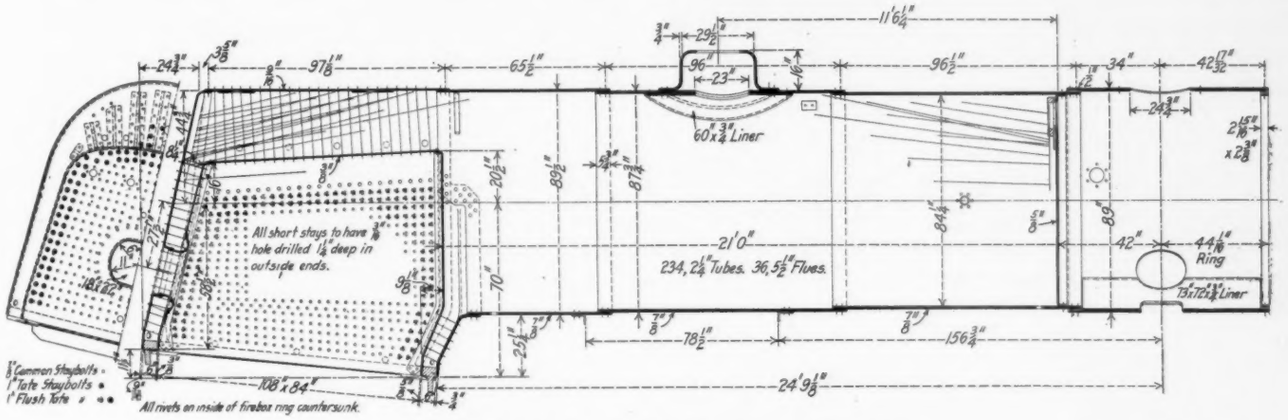
Typical Modern Freight Locomotive of the 2-8-2 Type; Rock Island Lines.



Locomotives of the 2-8-2 Type as Built for the Rock Island by the American Locomotive Company.

unusual was specified. The boiler is of the straight top type and measures 86 in. at the front-end, and the firebox is as deep and has as large a volume as it is possible to arrange. The mud ring at the throat sheet is 25¼ in. below the bottom of the barrel, which gives ample room for the installation of the brick arch tubes. The total depth of the firebox at the front

Outside steam pipes, which are now being almost universally used on new superheater locomotives, are included in this design. The steam distribution is controlled by 16-in. piston valves and the Baker valve gear on the Baldwin engines. Walschaert valve gear is used on those built by the American Locomotive Company. The cylinders are bushed, and are fitted with vacuum


All short stays to have ⅛" hole drilled ¼" deep in outside ends.
234, 2¼" Tubes. 36, 5½" Flues.
60" x ¾" Liner
42" 44 1/16" Ring
All rivets on inside of firebox ring countersunk.

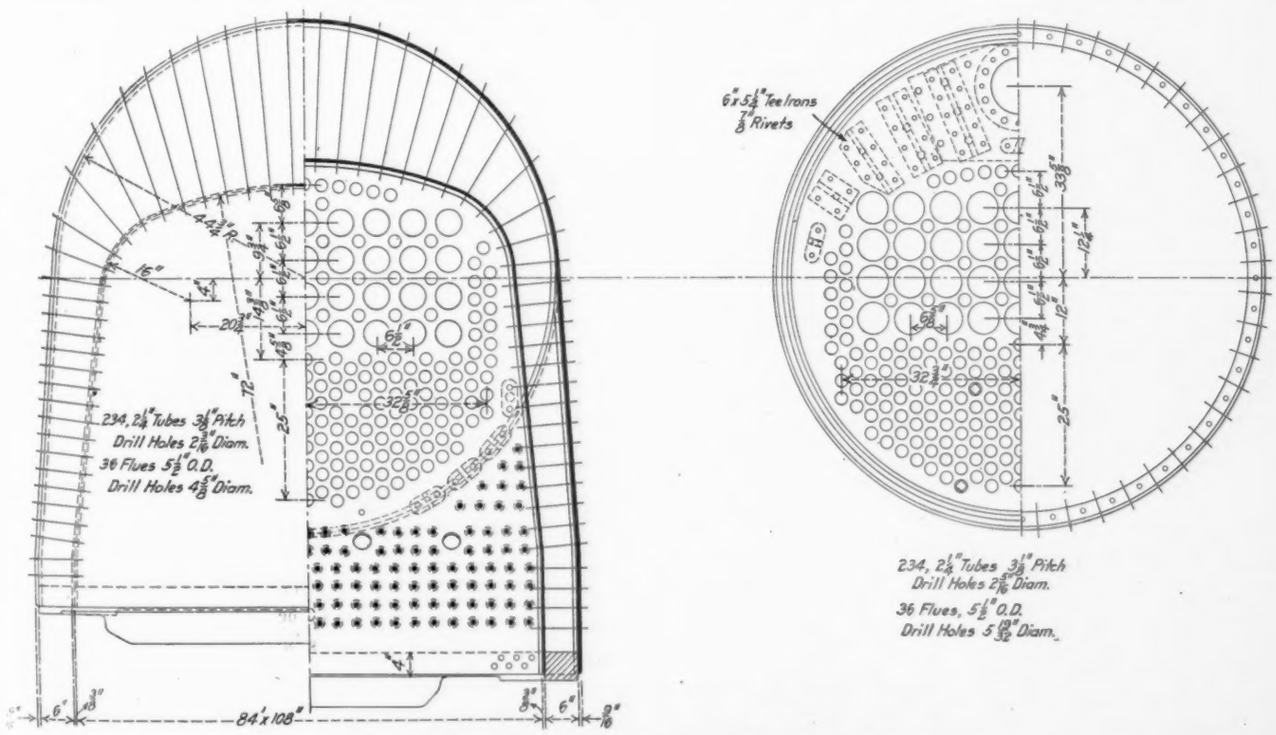
Boiler of 2-8-2 Type Locomotives for the Rock Island.

end is 90 in. The 2¼ in. boiler tubes are spaced with ⅞-in. bridges, and the 36 superheater flues are arranged in four horizontal rows in the upper part of the boiler. The dome is set well forward, being on the middle course, and is of steel plate, flanged from one piece. Flexible staybolts to the number of 550 are used in the firebox. The crown and side sheets are all in one piece, as is also the outside wrapper sheet.

Vanadium steel frames were specified. The main frames have

relief valves, as well as drifting valves. The piston rod is extended through the front cylinder head, and its crosshead is carried by a self-centering guide. The Ragonnet power reverse gear, operated by compressed air, has been applied to the forty built by Baldwins. The other ten have a screw reverse gear arranged as is shown in the elevation drawing.

The tender is of the Vanderbilt type, and carries 9,000 gal. of water and 16 tons of coal. The frames have plate steel end


234, 2¼" Tubes 3⅛" Pitch
Drill Holes 2 5/16" Diam.
36 Flues 5½" O.D.
Drill Holes 4⅝" Diam.
84" x 108"
6" x 5¼" Tee Irons
⅞" Rivets
234, 2¼" Tubes 3⅛" Pitch
Drill Holes 2 5/16" Diam.
36 Flues, 5½" O.D.
Drill Holes 5 13/32" Diam.

Sections of the Firebox and Boiler of the Rock Island Mikados.

a width of 6 in., and a depth of 7 in. over the pedestals. The front rails are single and are cast as an extension of the main frames. They measure 6 in. in width and are 11 in. deep at the connection of the cylinders. As a further source of strength there is a rib on the bottom of the frame 2 in. in width and 4 in. deep, extending the length of the cylinders.

sills, and the trucks have cast steel side frames and bolsters.

The general dimensions, weights and ratios of the Baldwin locomotives are given in the table below. The others differ slightly in respect to weights and heating surface. They have 238,000 lbs. on drivers, 52,500 lbs. on trailer truck and 29,500 lbs. on engine truck. This gives a total weight of 320,000 lbs.

There are 234 2¼ in. tubes and the total heating surface is 4,215 sq. ft., of which 252 sq. ft. is in the firebox.

General Data.

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort	57,100 lbs.
Weight in working order	318,850 lbs.
Weight on drivers	243,200 lbs.
Weight on leading truck	25,500 lbs.
Weight on trailing truck	50,150 lbs.
Weight of engine and tender in working order	480,000 lbs.
Wheel base, driving	17 ft.
Wheel base, total	35 ft. 2 in.
Wheel base, engine and tender	67 ft. 2½ in.

Ratios.

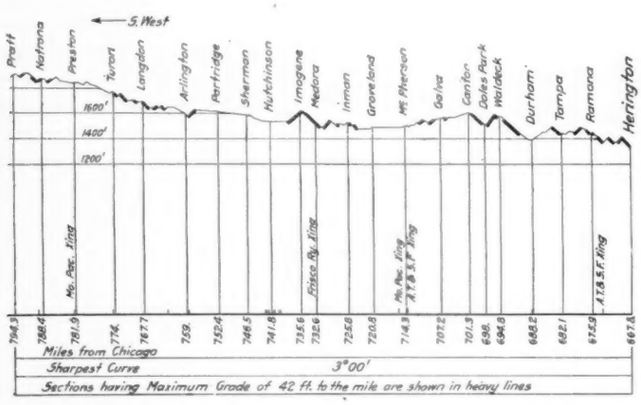
Weight on drivers ÷ tractive effort	4.26
Total weight ÷ tractive effort	5.58
Tractive effort × diam. drivers ÷ equiv. heating surface*	640.00
Total equiv. heating surface* ÷ grate area	89.10
Firebox heating surface ÷ total equiv. heating surface*, per cent	4.60
Weight on drivers ÷ total equiv. heating surface*	43.20
Total weight ÷ total equiv. heating surface*	56.40
Volume both cylinders, cu. ft.	21.40
Total equiv. heating surface* ÷ vol. cylinders	263.00
Grate area ÷ vol. cylinders	2.94

Cylinders.

Kind	Simple
Diameter and stroke	28 in. x 30 in.

Valves.

Kind	Piston
Diameter	16 in.
Greatest travel	6 in.
Outside lap	1 1/16 in.



Profile of Part of the El Paso Division of the Rock Island.

Inside clearance	1/16 in.
Lead	¼ in.
Type of valve gear	Baker

Wheels.

Driving, diameter over tires	63 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11½ in. x 13 in.
Driving journals, others, diameter and length	11 in. x 13 in.
Engine truck wheels, diameter	33 in.
Engine truck journals	6½ in. x 12 in.
Trailing truck wheels, diameter	42 in.
Trailing truck journals	9 in. x 14 in.

Boiler.

Style	Straight
Working pressure	180 lbs.
Outside diameter of first ring	86 in.
Firebox, length and width	108 in. x 84 in.
Firebox plates, thickness	⅜ in. and 5/16 in.
Firebox, water space	6 in.
Tubes, number and outside diameter	238—2¼ in.
Flues, number and outside diameter	36—5½ in.
Tubes, thickness and material	No. 10, B. W. G., Iron
Flues, thickness and material	No. 9, B. W. G., Steel
Tubes, length	21 ft.
Heating surface, tubes	4,004 sq. ft.
Heating surface, firebox	260 sq. ft.
Heating surface, total	4,264 sq. ft.
Superheater heating surface	848 sq. ft.
Grate area	63 sq. ft.
Center of boiler above rail	120 in.

Tender.

Type	Vanderbilt
Wheels, diameter	33 in.
Journals, diameter and length	6 in. x 11 in.
Water capacity	9,000 gals.
Coal capacity	16 tons

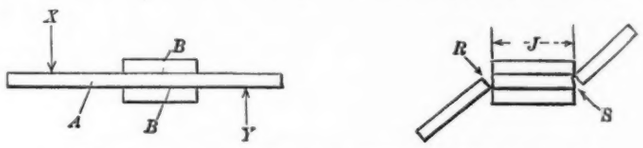
*Equivalent heating surface equals 4,264 + (1.5 × 848) = 5,536 sq. ft.

THE VAUCLAIN DRILL*

BY A. C. VAUCLAIN and H. V. WILLE.

Speaking generally, there can be no better definition of economical drilling than "rapid drilling"—the saving of time. The fact that a drill will cut at some phenomenal speed, or will consume such and such an amount of power means nothing so far as productive capacity is concerned. The object in view is the removal of chips.

The productive possibilities of any metal-cutting tool are limited by its stress and heat resisting capacities. The temperature at which it will continue to operate successfully depends on the

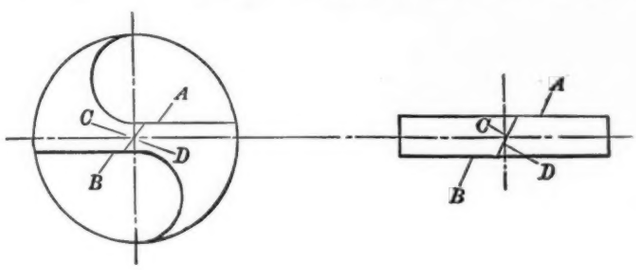


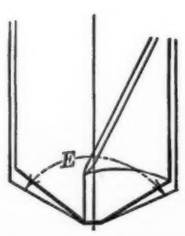
Splitting Action Illustrated by Means of a Wire in a Vise.

excellence of material and manufacture, but the rapidity of heat generation and the stresses set up in the tool depend on the design of the tool and the selection of feeds and speeds.

With a given excellence of material and manufacture, the strength of the tool must depend on the extent and disposition of the section. The size of the drill is necessarily limited by the size of the hole to be drilled. The section of the drill has a lesser area than that of the hole, since space must be provided for the discharge of chips from the hole. The design of the drill should therefore be that which will give it the maximum of strength and strength conservation.

Cutting stress is practically independent of the cutting speed,





Construction of the Commonly Used Types of Twist and Flat Drills.

and, with a given feed, is proportional to the lip angle of the cutting edge. The cutting stress does not increase as rapidly as the feed. The rapidity with which cutting heat is generated depends on the cutting speed, the depth of feed and the lip angle of the cutting edge.

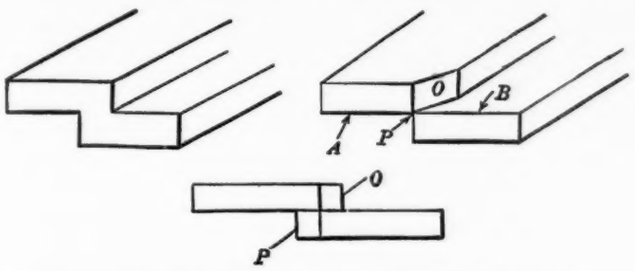
Since both the stress and heat are influenced by the keenness of the cutting edge, it is desirable that the lip angle be as small as possible. But it must be blunt enough to carry off the heat and to support the chip pressure, which falls more or less back of the actual cutting edge, according to the depth of feed. Since

*To be presented before the American Society of Mechanical Engineers at the December meeting. Published in the October issue of its *Proceedings*.

the chip is torn, not cut from the work, rupture between work and chip precedes the actual cutting edge. The heavier the feed, the farther back from the cutting edge will its pressure fall on the tool.

Under ideal conditions, the torsional capacity of the drill should be its limit of cutting strength. This does not obtain in the present commonly used types of drill, and they break down very considerably below their torsional strength. Why this is so will be explained later in detail.

The feed remaining constant, the horse power consumption will

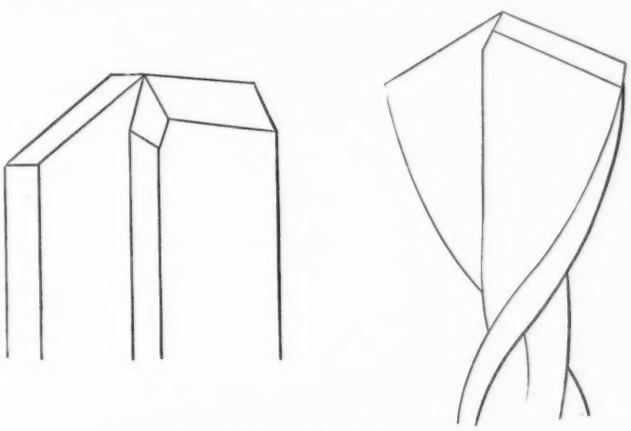


Diagrammatic Illustration of the Principle of Design of the Vauclain Drill.

be proportional to the speed. This is true both of the power consumed by the machine and that consumed in cutting. The speed remaining constant, the power consumed in cutting does not increase as rapidly as the feed and the power consumed by the machine remains constant for all feeds.

From this, it will be seen that the most economical method of chip production is by giving preference to the feeds rather than the speeds. Power, time and drills will be saved thereby.

The section scheme of drills now commonly used is shown in one of the illustrations. While there are many modifications of

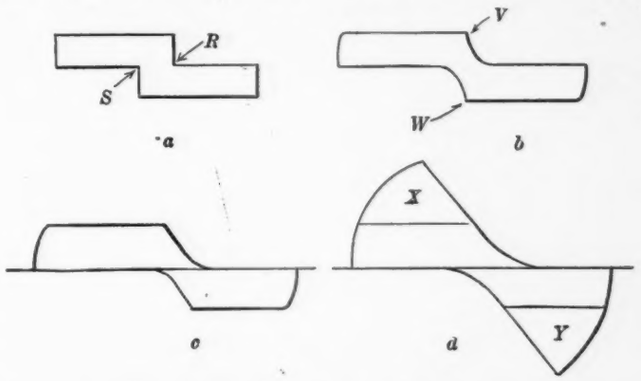


Bar Ground to Form a Drill and then Twisted.

these, they suffice to illustrate the common characteristic, which is that the cutting edges A and B pass to one side of the axis of motion of the drill instead of through the axis. In this respect there is no difference between the flat and twist drills. It will be seen that in this scheme the drill has four distinct edges, A, B, C and D, and that the usual name given to it of "two-lip" drill is not correctly applied.

It is customary for the included angle E to be of 118 deg., and the cutting edges C and D therefore have an unfavorable lip angle. These edges constitute what is commonly called the chisel point, and their cutting resistance is very great. The cutting edges A and B cut more freely than the cutting edges C and D and a tendency to longitudinal fracture of the drill is set up thereby. This is the cause of the splitting of drills. In explanation of this splitting tendency, one of the illustrations represents a section of brittle wire A held in vise jaws B. If sufficient pressure is applied, as indicated by the arrows X and Y, the wire will break at R and S, due to the resistance of the vise and to the forces X and Y tending to revolve it about its axis.

Those portions of the wire not within the vise jaws represent, in the drill, the cutting edges A and B, and are free cutting, due to their favorable lip angle. That portion of the wire held within the jaws represents the cutting edges C and D, or the chisel point, imbedded in the work and having to overcome a high cutting resistance due to the unfavorable cutting lip angle of these edges. Under very heavy feeds, these two edges tend to stand still, while edges A and B continue to cut, with the result that the drill is fractured in a manner similar to the breaking of the wire. In the drill the width of the vise jaws becomes in-

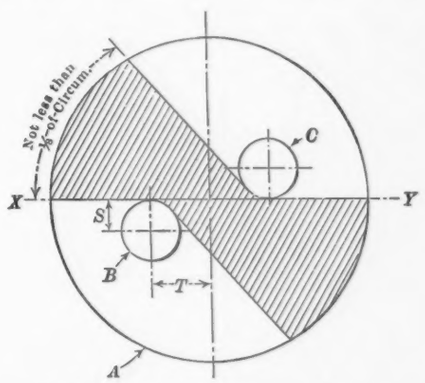


Successive Sections Showing the Development of the Vauclain Drill.

finitesimal and the fractures R and S coincide and constitute the longitudinal splitting of the drill.

In the commonly used types of drills there are but two methods of reducing the chisel point, viz.: by thinning the drill at its center, or by pointing. By the former method the resistance to longitudinal splitting becomes lowered, and by the latter method the cutting edges lose their support at and near the center of the drill.

By the foregoing it will be seen that the feed possibilities of the ordinary types of drills are not very great. Either the drill



Circle A=circumference of drill. Diameter of circles B and C=3/16 diameter of drill. S=3/32 of diameter of drill. T=3/16 of diameter of drill. XY=indicates cutting edges.

Diagram Showing the Exact Shape of the Vauclain Drill.

will split or its cutting edges will break under heavy feeds, long before its torsional capacity is reached.

The Vauclain drill is a "heavy feed" drill adapted to the most economical method of metal cutting and of great strength, due to its design. In order better to describe the drill, the section scheme will first be explained diagrammatically and the development of the actual section will then be illustrated. The first view shows a bar comprising two flat bars overlapping and integrally connected, as indicated. By beveling, as shown at O and P, in the next view, the edges A and B are made to

TABLE I—COMPARISONS OF STRENGTH OF VAUCLAIN AND ORDINARY TYPES OF DRILLS.

Test	Kind of Drill	Feed per Rev.	Speed R.p.m.	Inches per Min.	Holes Drilled	Total Inches Drilled	Compare to Test	Condition of Drill After Test	See Note
1	Regular	0 009	300	2 70	1	3.875	6	O. K.	
2	Regular	0.0145	300	4 35	1	3.875	7	O. K.	
3	Regular	0 020	300	6.00	1	3.875	8	O. K.	A
4	Regular	0 030	300	9.00	1	3.875	9	O. K.	
5	Regular	0 050	300	15.00	0	0.—	10	Broke—see note	
6	Vauclain	0.009	300	2.70	1	3.875	1	O. K.	
7	Vauclain	0.0145	300	4 35	1	3.875	2	O. K.	
8	Vauclain	0 020	300	6 00	1	3.875	3	O. K.	B
9	Vauclain	0 030	300	9 00	1	3.875	4	O. K.	
10	Vauclain	0 050	300	15.00	1	3.875	5	O. K.—see note	
11	Regular	0 009	170	1 53	1	3.875	16	O. K.	
12	Regular	0 0145	170	2.465	1	3.875	17	O. K.	
13	Regular	0.020	170	3.40	1	3.875	18	O. K.	C
14	Regular	0 030	170	5.10	1	3.875	19	O. K.	
15	Regular	0 050	170	8.50	see note	1.000	20 note	Broke—see note	
16	Vauclain	0.009	170	1 53	1	3.875	11	O. K.	
17	Vauclain	0 145	170	2 465	1	3.875	12	O. K.	
18	Vauclain	0 020	170	3 40	1	3.875	13	O. K.	D
19	Vauclain	0 030	170	5 10	1	3.875	14	O. K.	
20	Vauclain	0 050	170	8 50	1	3.875	15	O. K.—see note	
21	Regular	0 009	170	1.53	1	3.875	26	O. K.	
22	Regular	0 145	170	2.465	1	3.875	27	O. K.	
23	Regular	0 020	170	3.40	1	3 875	28	O. K.	E
24	Regular	0 030	170	5.10	..	3 875	29	Broke emerging	
25	Regular	0.050	170	8.50	..	.....	30-31-32	.....	
26	Vauclain	0.009	170	1.53	1		21	O. K.	
27	Vauclain	0.0145	170	2.465	1		22	O. K.	
28	Vauclain	0 020	170	3 40	1		23	O. K.	
29	Vauclain	0 030	170	5.10	1	see	24	O. K.	F
30	Vauclain	0.050	170	8.50	1	note	25	O. K.	
31	Vauclain	0.050	208	10.40	1		25	O. K.	
32	Vauclain	0.050	245	12.25	see note	1.000	25	Broke—see note	

A. Drill broke after point had penetrated to 7/8 in. diameter, broke into many pieces; split Torque is practically proportional to the square of the diameter, hence, since *A* broke when point had penetrated to only 7/8 in. diameter, *B* showed 170 per cent the strength of *A*.

B. Drill was permitted to emerge from work without knocking out feed; a slight crack in one cutting edge developed after drilling at rate of 15 in. per min. and emerging.

C. Drill broke into many pieces after penetrating 1 in. in last hole. Drilling at rate of 8.50 in. per min. split.

D. Since no heavier feeds were obtainable in the machine this drill was afterward run at 208 r.p.m. and 0.050 feed and broke only when emerging from bottom of hole; drilling at rate of 10.40 in. per min. and emerging. Taking into consideration that *D* emerged and *C* did not, the difference in strength is much greater than that indicated by the difference in inches per minute.

F In order to get an actual comparison with *C* which broke at 1 inch penetration, this drill was not allowed to emerge from the work. It broke drilling at rate of 12.25 in. per min.; after penetrating 1 in. Drill broke torsionally and did not split.

TABLE II—ENDURANCE TESTS OF VAUCLAIN AND ORDINARY TYPES OF DRILLS.

Test	Kind of Drill	Feed per Rev	Speed R.p.m.	Inches per Min.	Holes Drilled	Total Inches Drilled	Compare to Test	Condition of Drill After Test	See Note
33	Regular	0.009	300	2.70	42	162 75	34	Cutting edges worn	A
34	Vauclain	0.020	208	4.16	42	162.75	33	Cutting edges worn	
35	Regular	0.020	300	6.00	21	81 37	36	Cuttingedgesburned	—B
36	Vauclain	0.030	208	6.24	21	81 37	35	Cutting edges O.K.	
37	Regular	0.020	300	6.00	6	23 25	38–39	Badly burned	
38	Vauclain	0 030	208	6.24	26	105 75	37	Cutting edges O.K	C
39	Vauclain	0 030	208	6.24	35	135.12	37	See note	D
40	Vauclain	0.0145	208	3.02	20	...	41	O. K.	
41	Regular	0.009	208	1.87	20	...	40	O. K.	
42	Regular	0 009	300	2.70	11	...	43	O. K.	
43	Vauclain	0 0145	245	3 55	11	...	42	O. K	
44	Regular	0.009	300	2 70	10	..	45	O. K	
45	Vauclain	0.0145	245	3 55	10	...	44	O. K	
46	Vauclain	0.020	245	4.90	5	...	47	O. K.	
47	Regular	0 0145	245	3 55	5	..	46	O. K.	
48	Regular	0.0145	300	4 35	10	...	49–52	O. K.	
49	Vauclain	0.020	300	6.00	10	...	48	O. K.	
50	Regular	0.020	300	6.00	25	...	51	Burned corners	B
51	Vauclain	0:020	300	6 00	39	...	50	Burned corners	E
52	Vauclain	0 020	300	6 00	10	..	48	O K.	

A Cutting edges of Vauclain drill *less* worn than regular drill.

B Chisel point also burned.

C Broke in 26th hole by running into another hole.

D Spindle of machine ran hot, causing "jumping" of speed, and cutting edges; broken by resulting shocks. Drill at one period stood still, but did not fracture except at cutting edges.

E Point O. K.

meet at the axis of the bar. Since these beveled surfaces are at an angle with the axis the integral connection between the two flat bars remains unbroken.

The next two views indicate how the end of the bar would appear when ground to form a drill and how it would appear if twisted. Following this the first of the four end views gives the section of the bar in its original form. Introducing fillets at *R* and *S* gives the form shown in *b* and removing the corners *W* and *V* modifies it as in *c*. In *d*, by adding areas *X* and *Y* to the section, its torsional value is increased and the exact section profile of the drill is shown in the following illustration.

Tests have been made for the purpose of comparing the ordinary and the Vauclain types of drills. In order to secure uniform conditions care was taken that the different drills tested should be alike in quality of drill steel, heat treatment and tempering. The material drilled was a tough forging grade of steel of about 0.45 carbon. Tables 1, 2 and 3 show the horse power saved by giving the preference to the feeds, also the relative strength and endurance of the ordinary and the Vauclain types of drills. The size of drill used in all tests was 1 9/64 in. By examination of these diagrams it will be seen that the chisel point is eliminated without central thinning of the drill and without weakening the cutting edges.

TABLE III—COMPARATIVE TESTS OF ORDINARY AND VAUCLAIN DRLLS.

Test	Kind	Feed per Rev	Speed, R.P.M.	In. per Min.	H.P Expended	Per Cent Saving
53	Regular	0.00599	300	1 797	10 86	...
54	Regular	0.02	87	1.74	10.30	...
55	Vauclain	0.02	87	1.74	5.03	51.2
56	Vauclain	0 00599	300	1 797	4 73	56.4

Steel Guides.—J. J. Conolly, superintendent of motive power of the Duluth, South Shore & Atlantic, had a number of eight-wheel locomotives, fitted with the ordinary form of four-bar guides, made of wrought iron, case hardened, that gave a great deal of trouble by springing and breaking. This was remedied, and quite inexpensively, by substituting steel. The material was obtained from old driver tires. Before removing the tires from the centers they were turned off, leaving the flange as a rib, and were then cut to the proper width with a cutting-off tool, a ring of metal being cut from the outer face of the tire. This done, the tire was removed and cut to proper lengths, which were then straightened in the blacksmith shop. The wearing surface was then planed smooth and straight, the ends drilled and the guide applied. This not only makes a guide that does not break, but one that is stiffer and wears better than that first applied by the builders.

Back Pressure in Locomotives.—Locomotives have been built and are in service with steam passages of such dimensions or design that the back pressure can never be minimized as much as it should by any front end arrangement. Again, there are valve gears in use which do not permit of sufficient variation in the steam distribution, particularly in the four-cylinder type of compound engine, to properly relieve the back pressure. In my opinion these features should first be corrected; then the drafting arrangements in the front end are a matter of detail or of secondary importance, for it must be clear to all who have given the subject any thought, that where defects exist in either of the features I have just mentioned, very little, if any, benefit can be derived from front end adjustments, for if back pressure is caused by defective steam passages or valve gears it will exist regardless of the degree of refinement that may be obtained in front end adjustments.—*W. E. Symons at the Railway Fuel Association Convention.*

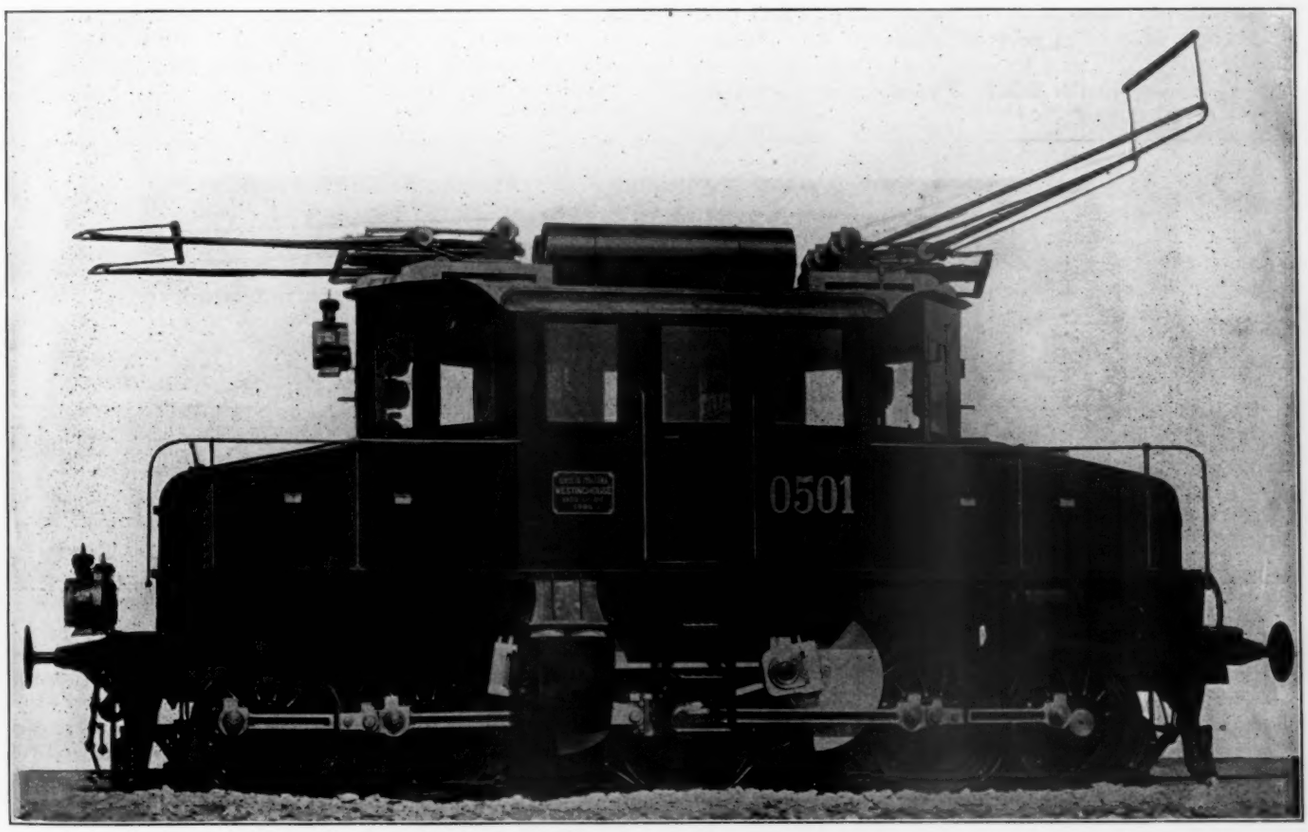
PROBLEM OF ELECTRIC LOCOMOTIVE DESIGN

A Discussion and Brief Description of the Various Types Now In Service in This Country and Abroad

BY N. W. STORER,
General Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

It has been said that the delivery of transportation is the business of all railways. The source of the power required for this work is one of the, if not the most, important elements that combine to produce this output. For many years the steam locomotive was without a rival. It had a complete monopoly of the business and like some other monopolies it lacked the incentive of competition. Since the electric locomotive entered the field, however, there appears to have been a great awakening among steam locomotive designers which has undoubtedly delayed all electrification of railways and possibly has prevented for many years at least the electrification of most of them. The improvements in the steam locomotive have led to the production of the enormous units that are now standard. These great machines have produced such excellent results that the electric locomotive has no longer such comparative advantages as were apparent even ten years ago, and while I believe that the electrification of a large part of our railways is certain to be accomplished at some time I also believe that the improvement in steam locomotives has removed the crying necessity for it, except in special instances.

The railways should not be pushed into terminal electrification by legislation before they are ready to handle the problem to the best advantage, for a large amount of money would have to be spent unnecessarily. The subject should be studied with the greatest care, the best system determined, and electrification adopted where there will be a distinct economic advantage.



Electric Locomotive with Side Rods and Scotch Yokes.

PROBLEM OF ELECTRIC LOCOMOTIVE DESIGN.

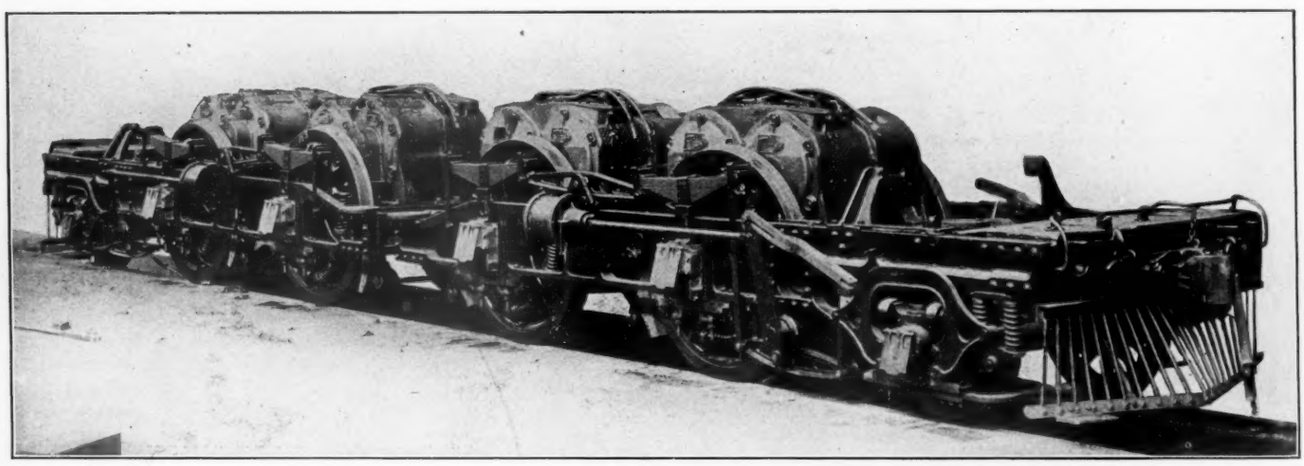
The manufacturing companies have done a tremendous amount of work in developing the various systems of electrification and the design of electric locomotives. It has been found especially that the low center of gravity on the electric locomotive of the type which was early proposed, instead of being an advantage, was a decided disadvantage, and it has been recognized for many years that one of the greatest problems, if not the greatest, in the electric locomotive is the transmission of the torque of the motor to the driving wheels. There have been a great many combinations proposed, and quite a large number of different types have been built and are now in operation, but there are very few transmission systems that are absolutely satisfactory from all points of view. In this respect, as in most others, every design is a compromise of the conflicting elements not simply in the locomotive itself, but on the roadbed and in the shop as well.

The necessity for a careful study by the manufacturers of the entire problem of railroading, if the best type of locomotive

* Abstract of a paper presented at the convention of the Association of Railway Electrical Engineers, Chicago, October 24, 1912.

is to be produced, is fully recognized by them. The designers of electric locomotives and the people who are to furnish the apparatus for electrifying railroads must come into closest touch with the operating officers of the roads, who should give them the benefit of their experience. No suggestion can be made that is too small to receive consideration. In the last analysis all must agree that the best locomotive is the one that will deliver the transportation required of it with the lowest sum total of expense. This, of course, not only includes the first cost, and the cost of maintenance and depreciation of the locomotive itself, but the first cost and cost of maintenance, depreciation and operation of the entire installation, as well as the cost of power at the locomotive and the cost of upkeep of the roadbed. It is because there is so little definite and reliable information on all these various subjects that there are so many different opinions concerning the systems of electrification and the proper design of locomotives.

The standard type of single reduction geared street car motor has been eminently satisfactory for street car service, but the difficulties connected with it have increased enormously as speeds and the power of motors have increased, until today it is generally believed to be poor practice to gear locomotives directly to the axle except for slow speed work. Several reasons have contributed to this belief: First, the spur gears are subjected to severe punishment when run at high speeds when rigidly connecting so much inertia in the wheels and the armatures, and to still greater punishment from shocks due to the roadbed. It has also been found that the pinions on the motor pushing downward on the gears are subject to much more severe treatment than when the motor pinion is pushing upward. Second; the dead weight of the motor is on the axle and its low center of gravity will cause serious injury to the track when operating at high speeds. There will also be a heavy side thrust of the wheel flange against the rail on curves and where the locomotive has a tendency to nose. Although steam locomotives have this same nosing tendency they do not injure the track because the mass or center of gravity is so high above it. This same feature should be sought for in the electric locomotive. Chiefly for these reasons the speed of most locomotives having heavy motors geared directly to the axles is limited to about 30 m. p. h. This type of locomotive, however, is comparatively simple and it is cheap and easy to maintain.



Running Gear of New Haven Electric Locomotive with Four Motors for Each Axle.

TRANSMISSION OF POWER IN ELECTRIC LOCOMOTIVES.

The big question is how to connect the motors with the driving wheels so as to provide a high speed locomotive that will have a reasonable cost of maintenance, and at the same time be a good riding machine; that is, one that will do the least possible damage to the track. There are several general types of such locomotives: First, those with motor armatures mounted rigidly on the driving axle, known as the New York Central type. Second, those with motors mounted on a quill surrounding the axle, which is the type of the original New York, New Haven & Hartford passenger locomotives. Third, the motor geared to a quill surrounding the axles, and connected to the wheels through long helical springs, which is the latest type of locomotive of the New Haven and some others. Fourth, motors mounted in the cab and driving through a jack shaft and a system of parallel rods such as are in use on the Pennsylvania Railroad. Fifth, motors mounted low between frames and connected to the drivers through a Scotch yoke. The Italian three-phase locomotive is of this type. Sixth, motors connected to the wheels by some combination of gears and side rods. That is the type used in the Loetschberg tunnel, Switzerland, and on the Midi Railway in France.

The first type has the disadvantage of a low center of gravity, but is a machine that is ideal in its simplicity in many respects. It has not been very successful for high speed work on account of its nosing tendency, which requires that the adjustments be kept in perfect order to reduce it to a minimum. The center of gravity of this type is about 44 in. above the rail.

The second type mentioned, that having the motor mounted on a quill surrounding the axles and connected to it through springs, is open to some of the same objections as the first type. This also has low center of gravity, although it is considerably higher than the first type, but all the weight is spring supported so that the track does not get the direct blow. The original New Haven locomotive nosed quite badly at high speeds, but by the addition of an idle axle at each end of the locomotive and a toothed cam-centering device between the cab and the trucks, this was entirely cured. The cam is arranged so that when the truck moves sidewise it must lift the cab, which tends to throw it back to the central position. The locomotives now have no tendency to nose even at speeds up to 75 and 80 m. p. h., where formerly they nosed badly at 50 and 60 m. p. h. However, even with the motors carried by springs, the track is liable to more or less damage unless it is kept in good condition. Every electric locomotive which goes to the New Haven must have no dead weight on the axles, as it is believed that any dead weight on the axle aside from the wheels and axles themselves is unnecessary and extremely detrimental to the track. Therefore, the motors are mounted on the quill with springs as described.

In the third type the motors are mounted above the axle and drive gears mounted on the quills. This type is used on the latest New Haven electric locomotive,* which has the same

*See *American Engineer*, July, 1912, page 363.

wheel arrangement as the original New Haven type. This locomotive has a high center of gravity and the quills are so spaced that they have a total play of 3 in. about the axle, 1½ in. above and below, which allows for imperfections in the track. These engines ride very smoothly. They have been in service on the New Haven and in the Hoosac tunnel on the Boston & Maine, and forty more are now under construction for the New Haven. This type has been built both with a single motor per axle and with twin motors of the same total capacity per axle. After building a number of the former, whose motors were so large as to require double gears, it was found that the same output could be obtained with less weight and less cost by substituting two motors for the one large one. This arrangement is illustrated herewith, and has the following advantages: First, only one gear is required, as both motors drive through the same gear. Second, the two motors are lighter and easier to handle and cheaper to maintain than the large one. There is no more chance for damage in the small motors than there is in the big ones, as they have practically the same number of coils in the motor and the same number of connections and commutator bars and brushes and brush holders as the big motors; and the small motors are much easier to repair and handle. Third, the motors in this case are interchangeable, with the exception of the field castings, with the motors which are used on the New Haven multiple unit motor cars. Fourth, two motors being connected permanently in series gives in effect one motor of double voltage, and consequently half current. This reduces the carrying requirements of cables and switches to one-half, and thus makes a substantial saving in the cost of control equipment. While these locomotives are now built for single phase operation, they would have practically the same advantages on direct current. The twin motor scheme adapts itself well to high voltage d. c. operation.

The fourth type of locomotive, that with the motors mounted high up in the cab and connected to drive wheels through cranks, parallel rods and jack shaft, is the type adopted by the Pennsylvania Railroad† for the New York terminal. They have a very high center of gravity and although the weight on the driving axle is about 56,000 lbs., and consequently requires stiff springs, the locomotive has riding qualities corresponding to the best steam locomotive. There is no tendency to nosing and no bad effects on the track. These locomotives are the most powerful electric locomotives ever built, and have shown themselves to be reliable, having a record for the first year, with 33 locomotives in service, of but 13 train minutes delay chargeable to the locomotives. They have a guaranteed tractive effort of 60,000 lbs. and have actually developed over 75,000 lbs. at the drawbar. This corresponds to a crank pin pressure of over 100,000 lbs. Of course, the normal pressure on crank pins is not nearly so high, but it is sufficient to impose strains on the jack shaft bearings that are very hard to hold. The locomotives will haul a train weighing as much as eight hundred tons up a 2 per cent. grade. The main rods are set at an angle of 45 deg., which is much to be preferred to the vertical motor rods adopted for the first locomotive built for the German State Railways. These were practically failures and it is understood that future locomotives will have motor rods arranged similarly to those of the Pennsylvania. It has been found that locomotives of this type require very careful adjustment to maintain the shafts parallel and properly centered and quartered.

The use of side rods on an electric locomotive introduces some different problems from those found in the steam locomotive. As there are no reciprocating parts such as piston rods, the parts are susceptible to perfect balance which is usually impossible in the steam locomotive. The rods must be very much larger than for a corresponding steam locomotive because the entire power has to be transmitted through one set of pins and rods at certain points in the revolution while the steam engine transmits the power from only one cylinder. The steam engine has another advantage in that the main rods on the two sides are connected to loose ends, while the rods on the two sides of the electric are connected to opposite ends of the motor shaft as well as the jack shaft, which introduces a great many chances for inaccurate workmanship in quartering and tramming and consequent knocking in the pins and bearings.

The fifth type of locomotive, that employing the Scotch yoke for transmitting the power from the motors to the driving axles, has been used exclusively for the three phase locomotives on the Italian state railways. The first ones have been in service some 10 or 12 years on the Valtellini line and have given excellent results. The later ones, some 35 in number, which are shown in one of the accompanying photographs, have been used about two years on the Giovi line near Genoa. These machines have some excellent qualities, light weight, powerful motors, and motor weight entirely spring supported. They have, however, been used only in slow and moderate speed service, so their performance at high speeds remains to be shown. These locomotives also require very accurate adjustment although not so close as the one with side rods and jack shafts, as the Scotch yoke drives one axle through a sliding block and the others through parallel rods connected to the yoke by knuckle pins. Spherical crank and knuckle pins are largely used with this type of drive.

The sixth and last type mentioned drives the locomotives through a combination of gears and side rods, or gears and Scotch yokes. A number of such locomotives have been built, the most notable being the one for the Loetschberg Tunnel in Switzerland and the one for the Midi Railway in France. The former has two 1,000 h. p. motors each connected by a helical tooth gear to a jack shaft, which is slightly above the driving axles, and thence by parallel rods to three pairs of driving wheels. Although the motor speed is extremely high, the gears operate practically noiselessly and with high efficiency. The duty on the jack shaft bearings is much easier than when side rods only are used, since the reciprocating pressures are practically all in a horizontal direction, and can therefore be cared for much more easily. Either of these types has a fairly high center of gravity. While either locomotive is subject to criticism for having both gears and side rods, it must be admitted that the arrangements for both are such as to give the best results. The jack shafts for side rod drive should be located in the same horizontal plane as the driving axles, consequently the problems connected with tramming and quartering, and with bearings would be reduced to a minimum. In some respects, this design is superior to either straight geared (gears on axles) or straight side rod types, and it is probable that a great many locomotives with gears and side rods will be built. The twin motors may be used here, thus reducing the gears to the lowest number or the smallest width of face.

†See *American Engineer*, December, 1909, page 490.

SHIPMENTS OF IRON ORE.—The total shipments of iron ore on Lake Superior was 36,338,382 tons to October 1, as against 24,837,137 tons to the same time of last year, which is an increase of 11,501,245 tons.

INSULATING STEEL PASSENGER CARS.—"I believe the difficulties of insulating steel passenger cars could be overcome by placing a strip of non-conductive material between the side post and inside finish and by eliminating the air space entirely. Vegetable fibre, filling the entire space, could be used to great advantage especially if this insulation could be manufactured so as to have a sponge-like appearance, thus dividing the space into millions of small and closed air cells. Such insulation would be cheap and effective and there would be no danger of fire as it is enclosed by fireproof materials. I am sure such a car could also be heated in the same way as our wooden coaches, and the efficiency in both cases would be practically the same."—*A. Stoikowitz before the Canadian Railway Club.*

ENGINE HOUSE SUPERVISION

BY A. C. LOUDON.

Ask almost any engine house foreman and he will tell you that he has so much to look after that he hardly knows where to begin; in fact, he is overloaded and much overloaded with work. The majority of engine house forces have not enough supervision, although this is not so much the case with large engine houses as those located at moderate size terminals. The more important engine houses require large appropriations for pay rolls and it is easier to work in an extra man or two than with a smaller one.

Take the case of a 20-stall engine house located in an eastern state and handling an average of 25 engines daily with a maximum of about 40 during the busiest season. The entire staff, including laborers and coal men, consists of 35 men and one foreman only. The practice followed is a common one. The foreman is on duty during the day and turns the work over at night to a hostler, who does not even have authority over the skilled labor. The results in such cases are almost always unsatisfactory. The foreman is waked during the night four or five times a week to settle questions that arise and concerning which the hostler and machinists will not accept responsibilty. After a few such night trips to the engine house he becomes worn out, his brain will not work properly, and he makes mistakes which result in engine delays, overtime and other unnecessary expenses. He is called to account for it, and all too frequently is discharged when he is not at fault and has not had a fair show, because he was overworked.

On the other hand if the foreman's rest is not disturbed, almost as much trouble results from blunders made by the irresponsible hostler. Lack of tact in dealing with the transportation officers is frequent in such cases, requiring long and involved explanations and apologies by the foreman. Blunders are made in holding engines for repairs that are trivial, or in letting engines go when they should be held, with engine failures resulting; and in calling enginemen out of their turn, resulting in the payment of "run arounds."

In the particular house under consideration there are two different hostlers with very different temperaments on night duty alternate weeks, and both these conditions prevail to a considerable extent. One man will accept no responsibilty and sends for the foreman in every case, while the other is anxious for authority and takes every opportunity to grasp it. The result is that between settling questions for one man at night and getting the other out of trouble during the day, in addition to his daily responsibility, the foreman soon becomes almost a physical wreck and escapes complete break-down only by taking a vacation.

The question may be asked, why are not one or the other, or both of the men discharged? The answer is simply that it is impossible to get a man capable of properly handling an engine house at night on twelve-hour shifts for $60 or less a month; and further, the education and training of the average hostler is not such as to fit him for such a position. No better men are available if these two are discharged and no more money can be obtained for better salaries. In fact the foreman's salary is only $1,000 per year.

That such a condition is undesirable will be generally admitted, but it can be remedied. First, give the foreman a reasonable salary. Without casting any slur on the many excellent men who have "made good" under prevailing conditions, it is nevertheless a fact that there are annually lost to the railways many men who would make good officers, and this mainly because of the low salaries paid. If a foreman be given a reasonable salary he will be more contented and much more willing to give the best of his powers to the solution of the problems before him.

Next, give him reasonable hours so that he can get his rest and keep himself physically fit to perform his work at all times. To accomplish this it will be necessary that he have a competent, well-paid night foreman to whom he can hand over responsibility at the end of the day. The night foreman should receive a salary reasonably near to that of the foreman and should stand in line for promotion to the foreman's position. It will help in his training to have him occasionally change off with the foreman, the latter taking the night shift. At such times each man should assume the full duties of the position he is at the time filling. This will familiarize the night man with the general office work, the handling of correspondence and the ordering of material. In case the foreman has had little or no night experience, as is frequently true, the change will familiarize him with what the night man has to contend with. The very fact that the night work has to be carried on in the dark makes it more difficult.

There should also be a competent "charge hand," or shop foreman, in direct charge of the men in the engine house. This man should have no work but the supervision of repairs, and if necessary should have gang foremen under him. The hostler can then handle the ash pit men and cleaners, and if the force is not too large, the coal men. The shop foreman should periodically change with the night foreman, and thus become familiar with his duties, while the latter, by coming back to the position of shop foreman, temporarily, will be prevented from becoming rusty on engine repair methods.

Another consideration in the case of the foreman is his clerk. Can anyone consistently claim that $50 a month is a reasonable salary for a clerk in an engine house office? The number of reports required from engine house foremen is legion, and it is continually increasing. The necessity and use of some of these reports may properly be held in question, but at the same time they are required by the master mechanic's office. Furthermore, they are required on specified dates, and if they are not in the office of the higher officer on those dates his chief clerk immediately begins to make life a burden for the engine house foreman and his clerk. It requires a man of intelligence to handle engine house office work and a sufficient salary should be allowed to attract a good class of men.

The burden of hand-written correspondence should also be taken off both foreman and clerk and a stenographer supplied, who could also act as an assistant clerk. Moreover, the stenographer should not be required to furnish his own typewriter, and he should be paid enough salary to insure getting a man who has at least a speaking acquaintance with the English language. The clerk will then be able to give proper attention to his reports, to develop methods and make suggestions for eliminating, combining or otherwise shortening them, and to work in close conjunction with the foreman in the matter of the efficient ordering and handling of material.

It is a good plan to periodically hold "get together" meetings of all the foremen, including the clerk. The discussions may cover anything coming up in the course of handling the engine house and will tend to encourage what is absolutely essential for the efficient working of any engine house—co-operation.

To apply these methods to the engine house under consideration would mean a direct increase in the monthly pay roll of at least $300, and consequently an increase in the cost per engine handled. On the other hand it is believed that the resultant economies would far more than offset this increase. The men would have direct supervision at all times and would not be required to waste time looking for the foreman to settle questions arising in the course of their work. By the closer supervision a rearrangement of the assignment of work could be made which would combine some duties and thus reduce the number of men required. It would reduce the number of engine delays and the number of engine failures, and, as a result of these, the number of train delays. It is impossible to

express such savings in figures. It would also tend to bring about much better relations with the transportation officers.

It would result in a much more efficient handling of material with a corresponding saving, and in the foremen being able to spend a portion of their time in developing labor and time saving kinks. The combined savings, if they could be expressed in money, would undoubtedly show a figure many times greater than the cost of the increased salaries.

There is, however, too much attention given in many cases to the cost per engine handled. Many motive power officers fix a flat rate per engine for all engine houses regardless of size and conditions. There are then two previously set quantities to deal with—the appropriation and the rate per engine. Consequently, if the engine despatch is too small to bring out the required unit cost, the foreman sees a call to the carpet coming his way and resorts to the easiest way, under the circumstances, of avoiding it—padding the engine despatch report. Undoubtedly a low unit cost is desirable and even essential, but fictitious figures should not be allowed, nor a low unit cost obtained, by poorly maintained power with its resultant demoralizing effects. Encourage engine house foremen to show their actual unit cost and give them more assistants to reduce the unit cost in an all-around efficient manner.

CAR SHOP KINKS

BY ALBERT W. HOLBROOK,
Draftsman, Boston & Maine, East Fitchburg, Mass.

ADJUSTABLE CLAMP.

The adjustable clamp shown in Fig. 1 is very serviceable in the car department carpenter shop for door, panel and sash work. It is made up of a wooden beam with a series of holes

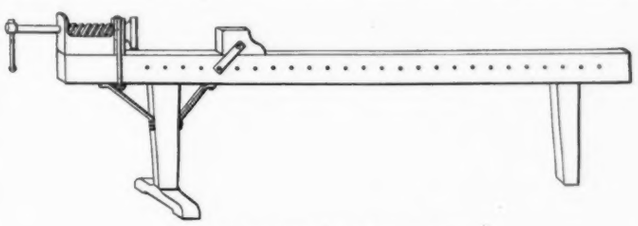


Fig. 1—Adjustable Sash Clamp.

so that the rear jaw or head may be adjusted. It is mounted on two legs, the front one having a cross piece at the bottom to give the necessary stability. The front head is provided with the regular vise screw.

WOOD BITS.

A series of special wood bits is shown in Fig. 2. Bit *A* is used for cutting out plugs for covering countersunk screws or bolts. One side of the bit does the cutting and the other side removes the chips. Countersinking bits are shown at *B* and *C*. These are used for boring screw holes requiring countersunk heads, *B* being used for heavy work and *C* for light work, such as box casings. Bits of this sort can be made from old machine tool drills.

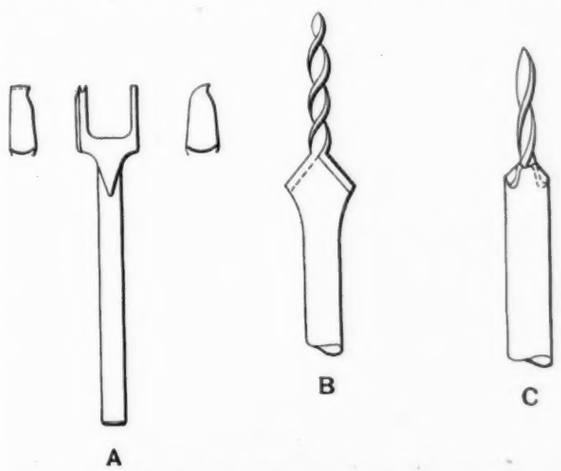


Fig. 2—Wood Bits for Car Work.

SWING CUT-OFF SAW.

The special feature of the swing cut-off saw shown in Fig. 3 is the truing rods on each side. These rods are fastened to the lower end of the saw frame and extend outward to the ceiling above. Each rod is provided with a turnbuckle, which allows

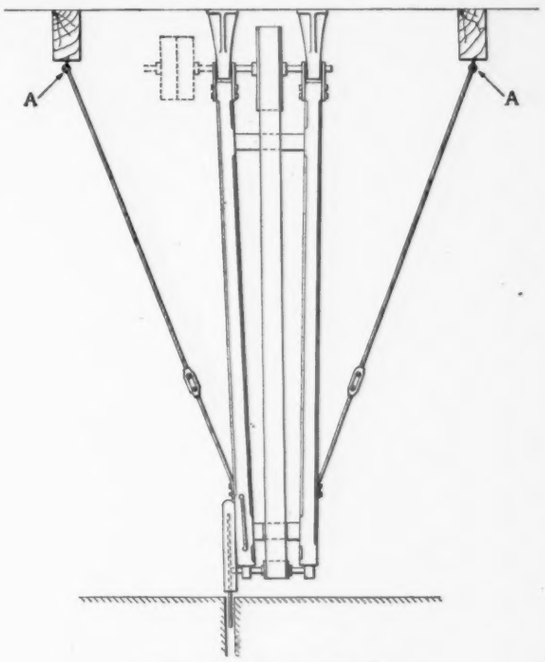


Fig. 3—Swing Cut-Off Saw.

an exact and rigid adjustment. Care should be taken when applying these rods to the saw that their upper joint *A* is on a line with the axis of the pulley shaft, for if they are not the frame of the saw will be strained every time it is swung. This arrangement keeps the saw running in a straight path and reduces the number of broken saws.

BENDING BRAKE SHAFT BEARINGS.

The arrangement shown in Fig. 4 is used for making brake shaft bearings or other forgings of this character. Two separate blocks, cut out to give the desired shape, are held by two links, as shown, one on each side. The bar to be forged is placed

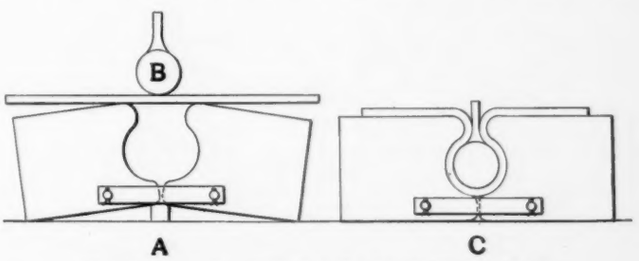


Fig. 4—Dies for Forming Brake Shaft Bearings.

on top of the dies with the blocks raised in the center by a wooden block, as shown at *A*. The plunger *B*, which may be applied to an air press or may be in the form of a set driven by a sledge hammer, then forces the iron bar into the die. At about one-half its stroke the wooden block or plug that holds the two dies open should be removed, allowing the blocks to fall on the level surface, as shown at *C*. This method is very

simple and allows the rods to be bent in one heat, giving a much more uniform bend than if done by hand.

SASH CLAMP.

The clamp shown in Figs. 5 and 6 is used to clamp sash on all four sides. The end clamps *E E* are operated through the rod *B* which is connected to one end of the lever *C*, the left hand one being connected to the lever through the rods *F* and *G*. The opposite clamps *H* are held by set screws, and may be adjusted in the slot in which they are set. The side clamps are connected

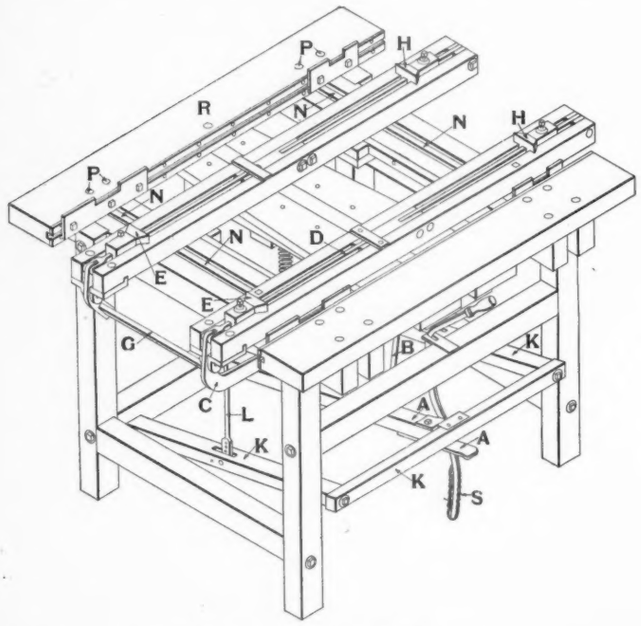
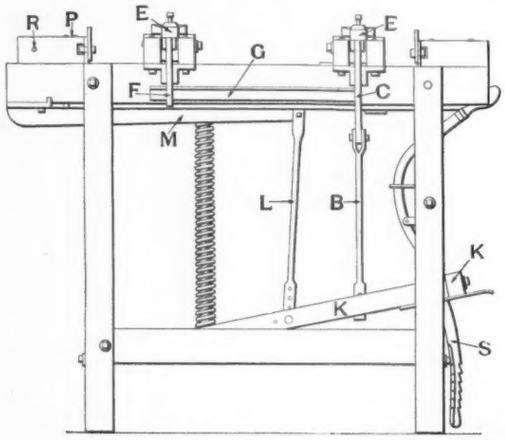


Fig. 5—Four-Sided Sash Clamp.

to the treadle through the rods *L* and the levers *M*, which move the clamp jaw *R*. The treadle is held in the clamped position by the notched lever *S*, which has two sets of notches at right angles to each other. The notches on the side are used to engage the treadle *A*, which operates the end set of clamps, while the other notches are used for the treadle *K*, which operates both the side and end clamps together.

WHEEL GAGES.

The gages shown in Fig. 7 are used for mounting wheels on axles. Gage *A* is used to determine when the wheel has been



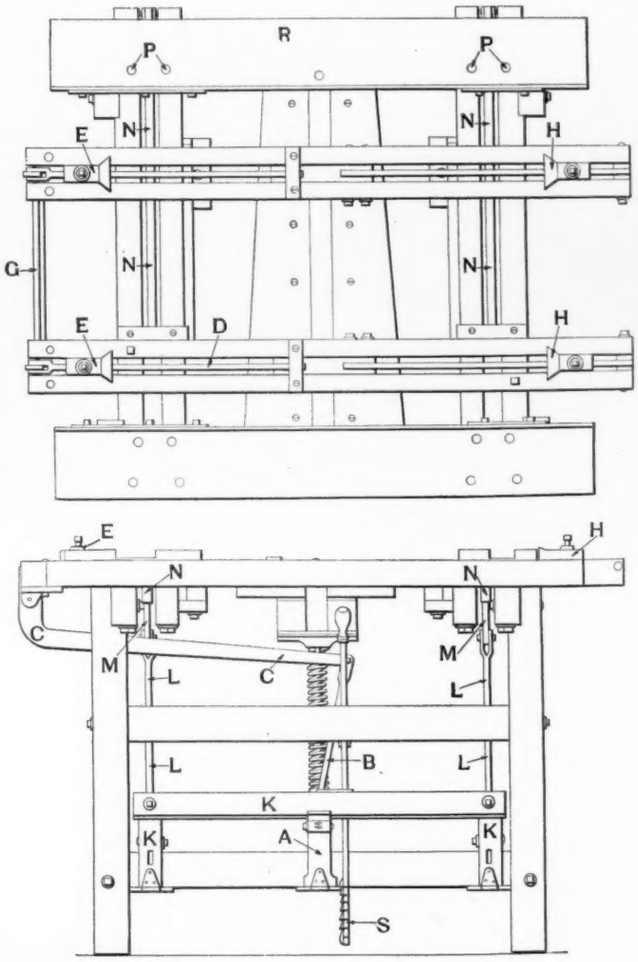


Fig. 6—Side, End and Top Views of Sash Clamp.

pressed on far enough. The center of the axle is first located and the axle placed in the press ready for the wheel. The broad end of the gage is placed on the inside of the flange, as shown, while the other end extends along the axle; the wheel is forced on until this end coincides with the center of the axle. The other wheel is applied in the same way. The gage *B* is

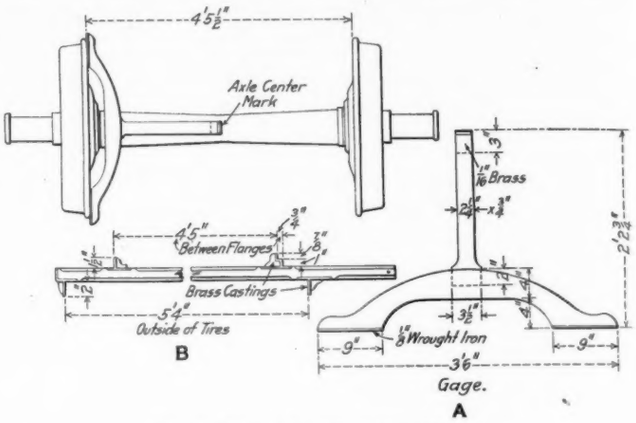


Fig. 7—Gages for Mounting Wheels.

used for measuring the distance between the flanges and the outside of the tires.

INDIAN RAILWAYS.—During 1911 seven hundred and fifty miles of new railways were opened in India, which makes a total of 32,839 miles. There were 390,000,000 passengers carried and 71,270,000 tons of freight. The return on the capital invested in the lines in operation amounted to 5.87 per cent.

THE BAKER LOCOMOTIVE VALVE GEAR

A Description of the Gear, an Analysis of Its Motions and the Method of Setting Valves.

BY R. S. MOUNCE.

The Baker locomotive valve gear in its present form is the result of a development extending over several years. The proof of its merit lies in the fact that its use is being extended, not only on new locomotives, but also on old ones, especially in cases where the Stephenson gear has been unsatisfactory on account of the springing and consequent distortion of valve events resulting from long valve rods or long eccentric rods. It was thought at one time that the Walschaert gear successfully met every disadvantage of the Stephenson gear. It did greatly reduce the weight of the reciprocating parts and the areas of wearing surfaces, but it does not eliminate the troublesome shifting link with its sliding block, nor does it materially improve the steam distribution. The Baker gear resembles the Walschaert in many respects and offers every one of the advantages claimed for the latter, but with three important additional advantages, which are:

(1) The oscillating link, by far the most troublesome part of the Walschaert gear, is eliminated, and for it are substituted in the Baker gear a set of levers, all of whose connections are of the pin and bushing type.

(2) The Baker gear has in actual test shown a saving of more than 5 per cent. in steam consumption for a given power over the Stephenson gear, and while the saving might not be quite so great over the Walschaert, it would nevertheless be considerable.

(3) The total weight of the reciprocating parts of the Baker gear is considerably less than that of the Walschaert.

In general, the Baker gear, on account of its entire lack of sliding connections, the fact that each bearing is essentially of the pin and bushing type, and because of its extremely light weight and rigid construction, will undoubtedly require less maintenance than other outside gears; besides, the accuracy of its valve setting will remain for a much longer period due to its necessarily slight wear.

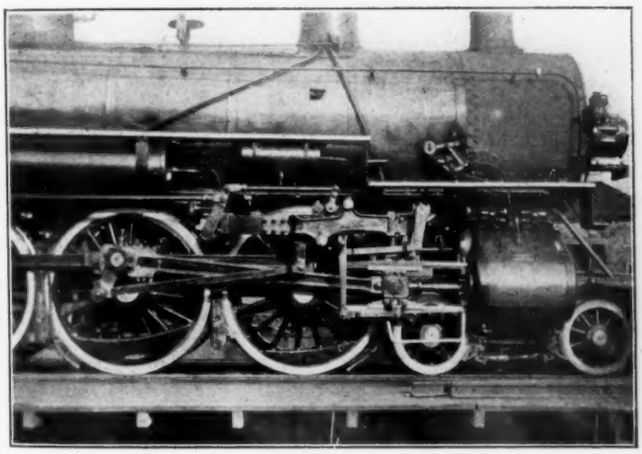


Fig. 1—Application of Baker Valve Gear for Inside Admission.

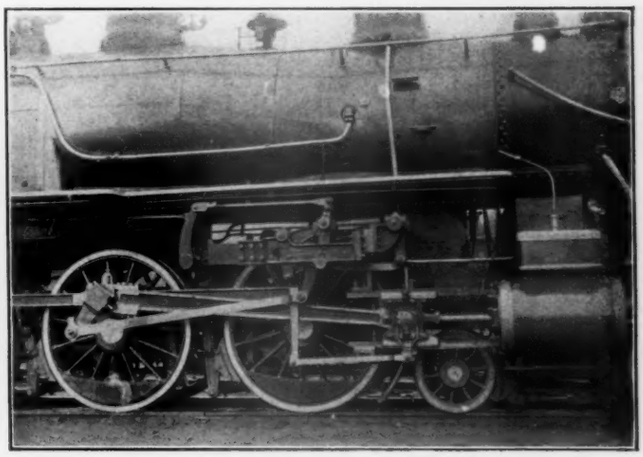


Fig. 2—Application of Baker Valve Gear for Outside Admission.

ANALYSIS OF THE MOTION.

The following description refers wholly to the kinematic diagram, which shows the Baker gear arranged for inside admission valves. For outside admission valves two changes are made, namely: the fixed center G (Fig. 3) of the bell crank is located back of the fixed center A of the reverse yoke, and the upper arm FG points forward instead of backward; and the valve rod connection K of the combination lever is above its bell crank connection H, instead of below it. In all cases the eccentric crank pin follows the main crank pin at an angle of approximately 90 deg.

The crank pin circle, Fig. 3, is divided in twelve parts. Each division is numbered and the corresponding number is placed on the path of each moving part in order to show its position in relation to the crank pin during one revolution in forward motion. The diagram shows the exact path of each part of the Baker gear during one complete cycle in full gear forward motion. The position No. 10 for which each part is shown by full line center lines was selected because it shows the parts most clearly in their respective relation to each other.

The motion imparted to the valve is a combination of two motions: one, from the eccentric rod, transmitted through the eccentric rod, gear connection rod and bell crank, which causes the valve to follow the piston at an angle of 90 deg. (with outside admission valves the valve leads the piston at the same angle), the other from the crosshead through the combination lever, which at mid-valve stroke displaces the valve from its mid-position a distance equal to the sum of the lap and lead.

The reverse yoke and the radius bar take the place of the link and link block in the Stephenson or Walschaert gear. They comprise the reversing mechanism and the direction and amount of motion transmitted from the eccentric crank is determined by the position of these two parts. The middle point of the gear connection rod is attached to the lower end D of the radius bar, whose upper end is attached to the reverse yoke at B. The point D can move only in an arc of a circle whose center is at B. The upper point of the gear connection rod is attached to the bell crank at F and can move only in an arc of a circle whose center is at G. The shape of the path of the lower point E of the gear connection rod, to which the front end of the eccentric rod is attached, is therefore determined by the two arcs FF' and Dd. It is seen that when the point B falls on the arc FF', the point F will be a stationary point and no motion will be transmitted to the valve from the eccentric crank, and

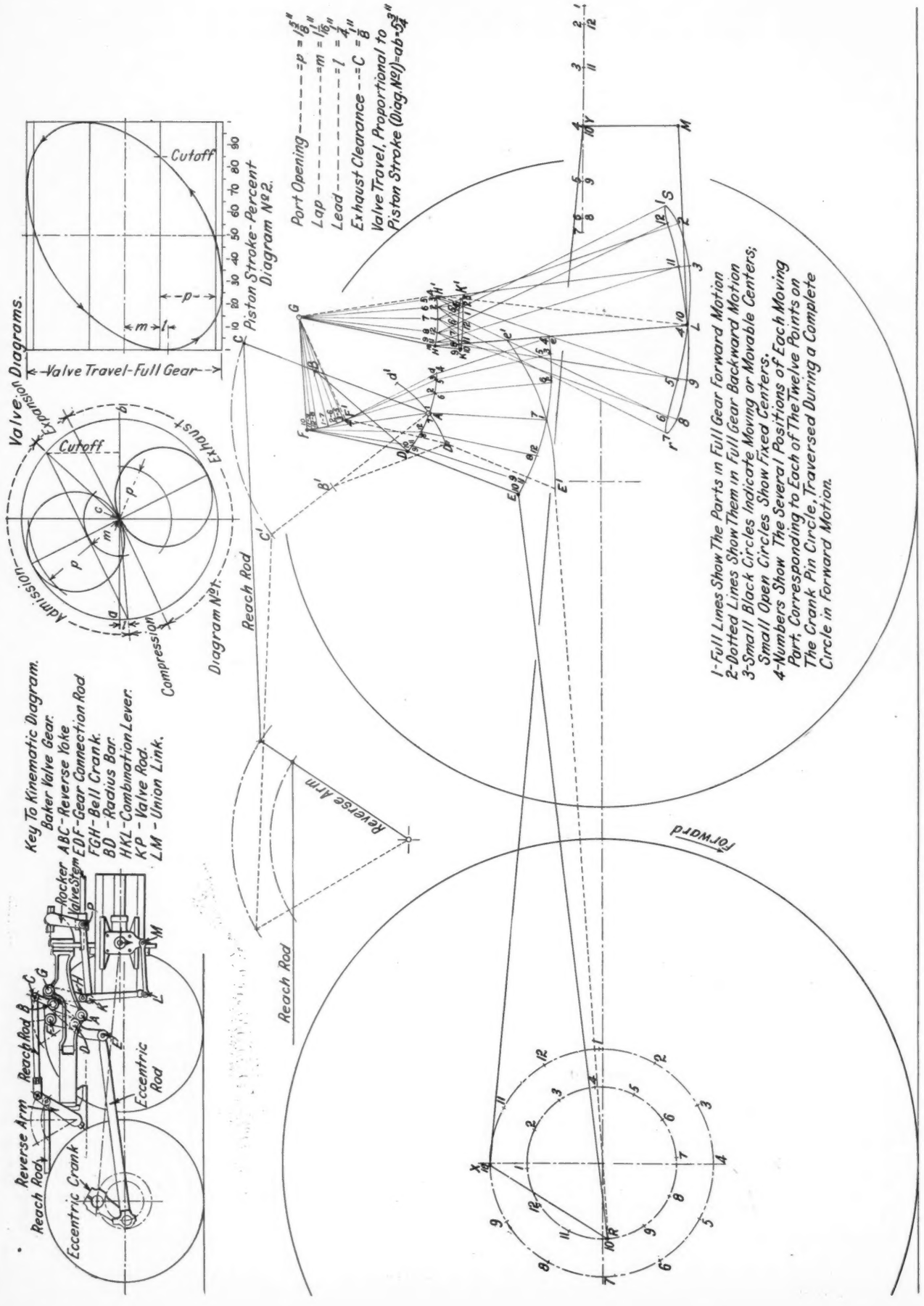


Fig. 3—Kinematic Diagram of the Baker Valve Gear With Inside Admission Valves.

the nearer this point approaches the arc FF', the shorter will be the motion imparted to the valve; also when the point B is drawn past this arc, the direction of motion of the point F relative to the motion of the piston will change and consequently the engine will be reversed. It is to be noted that the lower point of the bell crank H travels through the same angle as does the point F, and that the function of the bell crank is simply to transform the motion from vertical to horizontal. The foregoing explains how the gear is reversed and how the travel of the valve is decreased and the cut-off shortened by "hooking up" the reverse lever. The dash line center lines show the change in position of each part of the gear when the reverse lever is placed in the back notch—main crank pin, eccentric crank and crosshead remaining stationary.

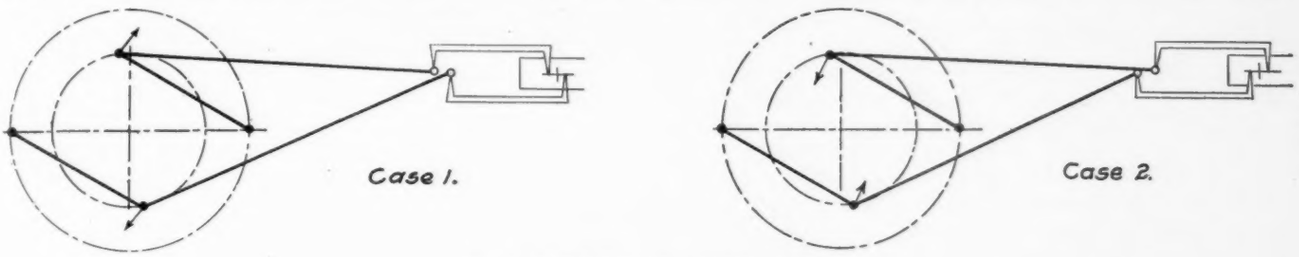


Fig. 4—Adjustment of Eccentric Crank.

Valve diagram No. 1, Fig. 3, is drawn to suit the dimensions of the valve and parts. It shows the long port opening and the free exhaust obtaining at full gear. Diagram No. 2, Fig. 3, shows the valve ellipse for full gear plotted from the kinematic diagram. There are three points to be noted. (1) That the port is fully opened when the piston has traveled 14 per cent. of its stroke and that this occurs so rapidly that the effect of pre-admission due to the ¼ inch lead is practically eliminated. (2) That there is a dwell of about 35 per cent. on the full port opening. (3) And that, although the port closing requires about 36 per cent. of the stroke, the velocity of the valve movement is great enough to give a quick cut-off. These facts go to show why a material saving in steam consumption is possible by the use of the Baker gear.

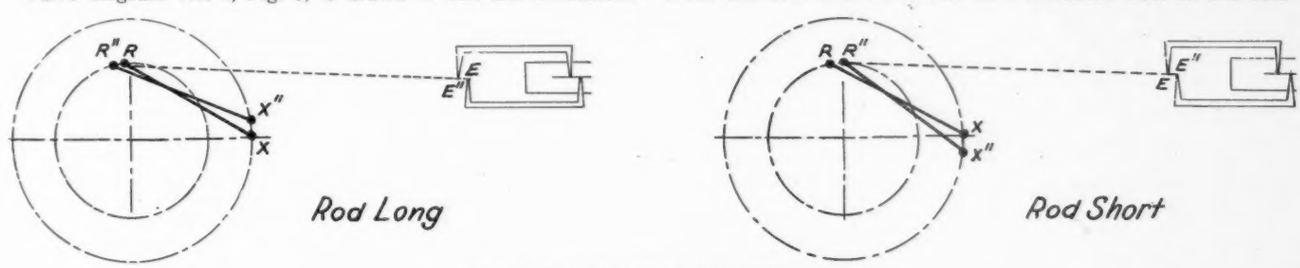


Fig. 5—Adjustment of Eccentric Rod.

SETTING THE VALVES.

The method used to set the Baker gear is in some respects similar to that practiced in setting the Walschaert gear. The several steps required are given below in their proper order. The right side of the engine is generally considered and it is not necessary to make a further explanation for the left side. These rules apply to either outside or inside admission valves. The parts mentioned in the following discussion are shown on the kinematic diagram.

(1) The combination lever should first be checked to the blueprint to make sure that the two arms are of the proper length. This will insure the proper lead when the other parts have been adjusted. The length of the union link should then be checked by plumbing the lower arm of the bell crank and the combination lever which is connected to it. Then with the crosshead in its mid-stroke position see if the length between centers of the union link corresponds to the distance between the center of the crosshead arm and the center of the bottom hole of the combination lever. If the difference is over ½ in. the union link should be adjusted.

(2) Connect up the valve gear and both main rods. Obtain the dead centers as usual.

(3) *To Place the Eccentric Crank in Its Proper Relation to the Main Crank.*—The reverse lever can be at any position during this adjustment. Catch either dead center and from a point near the front end of the eccentric rod make a tram mark on the face of the top guide bar. Then catch the other dead center and from the same point on the eccentric rod make a second mark on the upper guide. The two marks should coincide. If they do not it is necessary to move the eccentric crank further from the center of the wheel or nearer to it, as the case may be, until the two tram marks coincide. See Fig. 4 for an illustration of these two cases. The amount of this change should not be very great, because if the diameter of the eccentric crank circle is materially increased or diminished, it may be necessary

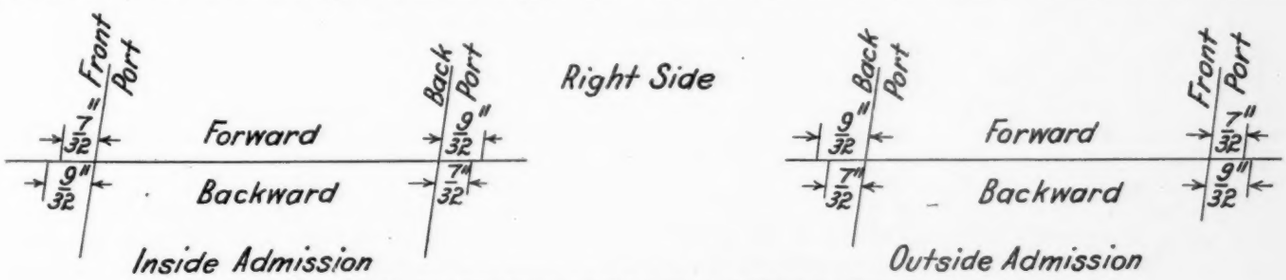


Fig. 6—Correct Adjustment of Valves of Baker Gear as Shown by Marks on Valve Stems.

to shorten or lengthen the eccentric crank in order to maintain the proper eccentric crank pin travel.

(4) *To Adjust the Length of the Eccentric Rod.*—With the reverse lever in the front notch and the wheel placed on either dead center (assume that the front center is selected), make a mark on the valve stem with a valve tram, Fig. 5; then place the reverse lever in the back notch and make a second mark on the valve stem. If the two marks coincide the eccentric rod is of the proper length. If they do not coincide, it is evident that the rod is either too long or too short. In that case, move the wheel about one inch backward from the dead center and go through the same procedure as described above. If the tram marks come nearer together it shows that the rod is too long and it is simply necessary to move the wheel further from the dead center until a point is found at which there will be no movement of the valve stem when the engine is reversed. This point having been found, tram from the same point on the front of the eccentric rod used in paragraph (3), making a mark on the top guide. Then return the wheel to the forward dead center and make a second tram mark on the guide. The distance between these two marks is the amount the eccentric rod will have to be shortened.

If, when the wheel is moved backward from its forward dead center, and the process outlined above has been followed, the valve stem movement increases, it shows that the eccentric rod is too short. In that case, move the wheel ahead of its forward dead center until a point is found at which there will be no movement of the valve stem when the engine is reversed, then return to the dead center and proceed as described before. The distance between the two tram marks made on the guide will be the amount which the eccentric rod will have to be lengthened.

It has been found best to leave the eccentric rod about ⅛ inch short in order to give a better equalization of the cut-off from shopping to shopping, making allowance for the wear of the parts and the settling of the engine in service. This will, of course, throw the lead out about 1/32 in., but it is generally acknowledged that a slight variation in the lead is of much less importance than unequal cut-offs.

The reason for the adjustment just described can be readily understood by referring to the diagram. It is seen that the points 1 and 7 correspond to the dead centers. When the crank pin is located at either of these points, the front end of the eccentric rod is at the point of intersection (1 and 7) of the full gear forward and full gear backward paths, *Ee* and *E'e'* and that if the eccentric rod is of the proper length, there will be no movement of the front end of the rod (and no motion transmitted to the valve rod) when the reverse lever is moved.

(5) *To Adjust the Valve Rod.*—Another adjustment to be made is that of the valve rod, and the method of doing this is too well known to require any explanation here.

(6) *To Adjust the Valve Travel.*—It is assumed that the main reach rod was adjusted when applied, so that with the reverse lever in mid-position, the reverse arm stands plumb. After the other adjustments have been made, the backward and forward full gear travel should be equalized by adjusting the short reach rods which connect the reverse arms to the reverse yokes. If the rules are followed as outlined there should be practically no variation in the cut-offs. If, however, there should be any great variation, it may be necessary to make a further change in the length of the eccentric rod. If cut-offs are long on the front end in forward motion and short on the front end in backward motion, the rod is too long. If cut-offs are just the reverse, then the rod is too short. When the adjustments have been made and the valves are run over for checking, the marks on the stem should be as shown in Fig. 6.

The last job to be done in setting the Baker gear is to key the eccentric crank fast to the main crank pin. This is left until last, so that any variation from that source may be detected while there is still opportunity to make a correction.

The two photographs show the Baker valve gear applied to passenger engines, both of which were formerly equipped with the Stephenson gear. One has inside admission, and the other outside admission valves.

VALUE OF VARIABLE EXHAUST NOZZLES*

Some ten years ago while studying the question of locomotive design and operation abroad, I frequently rode on French locomotives and noticed particularly the degree of refinement obtained in the steam distribution of four-cylinder compound engines. I have ridden in the cab of a French locomotive of this type handling a passenger train at a speed of from 90 to 100 kilometers (56 to 62 miles) per hour, when, by a slight adjustment of the valve gear, which resulted in lowering the back pressure on the low pressure pistons, the engine immediately increased its speed by about 15 kilometers (9 miles) per hour without supplying any more steam from the boiler or increasing the throttle opening. I think it safe to say that if the officers of the American railways would give this matter more thought and study, providing means whereby locomotives should primarily be provided with steam passages and valve gears offering the least possible resistance in the way of back pressure on the pistons while in operation, then with an adjustable exhaust nozzle permitting a variable adjustment to meet the different conditions of service, and then finally following up the valuable suggestions in Mr. McFarland's paper,† they could decide on certain standards of design suitable for all localities that would result in saving much more than many of the devices which are now being applied to locomotives, give in the way of a return on the money invested.

I do not wish to be understood as criticizing either the compounding or the superheating of steam from an engineer's standpoint, for a man who would criticize or condemn either would thereby automatically eliminate himself from the ranks of the engineering profession or of progressive railway men. There are, however, cases where men become so completely absorbed in a certain thought or idea that they are unconsciously oblivious to others of as great or greater importance, and I think it is not overstated to say that in many instances men in the engineering, as well as in other professions, have ridden a hobby when there were other directions in which they could better apply their energies. In other words, in railway practice, there are some cases even at the present time where it would seem that those in charge of the design and operation of locomotives were almost stumbling over $10 bills in their effort to locate nickels and dimes.

Doubtless many of the locomotives in service which show excessive back pressure are equipped with superheaters costing $1,200 to $1,500, and in many kinds of service the investment will bring good returns in a very short time. I think it might safely be said, however, that in many cases the engines thus equipped could, at an expense of $50 or less, be fitted with a variable exhaust nozzle that would bring even greater returns in the way of increased efficiency. Again, valve gears designed so as to permit of independent adjustment between the high and low pressure engines are also conducive to the same results and are considered by many of the foremost engineers on the other side as absolutely essential to the economic operation of four-cylinder locomotives. In this I am inclined to think they are entirely right, and that we in America have overlooked this very essential feature, together with the other features which I have already mentioned.

* Part of a discussion by W. E. Symons at the convention of the Railway Fuel Association.

† Locomotive Drafting and Its Relation to Fuel Consumption. See *American Engineer*, June, 1912, page 300.

ACCIDENTS IN SHOPS AND ENGINE HOUSES

An Address Before the First Co-operative Safety Congress Which Was Held at Milwaukee Last Month.

BY GEORGE BRADSHAW,
General Safety Agent, New York Central Lines.

The great majority of injuries in shops and enginehouses naturally occur in the use of tools, machinery and appliances. Of the preventable portion of this class of injuries, according to my observation, a larger percentage is due to improper physical conditions than to improper methods or personal carelessness. It follows, therefore, that the chief factor in the prevention of injuries from these sources consists in the installation and maintenance of proper safeguards. In other words, while training of the "human element" is important in shops and enginehouses, as elsewhere, and should not be neglected, it is believed that in these particular branches of the service, the most serious attention should be given to a regulation of physical conditions.

For many years, voluntarily or otherwise, we have been adding safeguards to our cars and engines until today it is difficult to think of additional mechanical devices to make this class of equipment more safe. But while we have been turning out cars and engines well nigh perfect in this respect, until recently we have done practically nothing in the way of protection, by safeguards, from injury by the numerous complicated and hazardous machines used in the manufacture and repair of this equipment.

It is true we have safety appliance laws in most, and perhaps in all states, and factory inspectors whose duty it is to assist in their enforcement. The fact remains, however, that not until recently has a great deal of attention been paid to these laws. Their purpose is all right, but they are too general and indefinite, and railway men are beginning to realize that safety laws and factory inspectors can at best accomplish only a small part of what is really required to make our machines and shops reasonably safe. In all of the large shops of the New York Central Lines we have, and have had for some time, a force of men working continually installing safeguards. This work is being done in spite of the fact that inspections have been made by factory inspectors and the shops pronounced O. K. We knew they were not O. K., because we read the accident reports. But we are trying to make them O. K. and believe they will be when we get through with them. Following are some of the principal causes of injuries in shops and enginehouses:

UNGUARDED MACHINERY.

The safeguarding of machinery is a subject too extensive to be treated in detail within the limits of this paper. I shall, therefore, attempt to discuss the matter only in a general way. Familiarity with machinery arising from constant use has a tendency to create in the minds of many operators a sense of disregard for the hazards existing and, in fact, in the minds of some, even a contempt for such hazards. The application to a machine of a practicable safeguard not only serves to prevent injuries which might result from the use of the machine, but, at the same time, serves indirectly the useful purpose of impressing upon the operator the importance of safety precaution on his part. In other words, safeguards exert both a mechanical and moral influence.

In the application of a safeguard it should be remembered that we are obliged to protect not only the careful but also the careless employee. In fact, so generally and completely should machinery be guarded that even the most careless and reckless man in the shop will be protected. Safeguards, wherever possible, should be so constructed that they will provide automatically the necessary adjustment, as, for instance, guards over gears at the ends of lathes, which must necessarily be opened in order to adjust the gears, should be attached to the machines by hinges so that the guards will swing shut into place of their own accord, thus preventing a careless operator from removing them or affecting their efficiency. Guards for circular saws should extend completely over the teeth of the saws and be adjustable by means of gravity to varying thicknesses of timber. In other words, where possible, a safeguard should be made "foolproof." Following are some of the machines for which safeguards are especially necessary:

Planers.—The openings in the base of planers beneath the carriage should be covered by thin sheet metal to prevent employees from depositing therein material or tools, thus rendering themselves liable to be injured by the movement of the carriage. If this cover is properly applied it will not in any way interfere with the operation.

Band Saws.—The upper and lower wheels should be completely enclosed on both sides. The teeth on the back or return part of the saw between the table and the upper wheel should be protected by means of angle irons so that the operator cannot come in contact with them. There should also be an angle iron or other form of protection in front of the wheels to prevent the saw from flying and striking a workman in case it should break.

Set Screws on Revolving Spindles.—These, wherever located, should be countersunk or protected by safety collars. Many serious injuries result from exposed set screws.

Flywheels, Pulleys and Gears.—When within seven feet of the floor they should be enclosed so as to prevent contact with movable parts which might occur on account of slipping or falling, or on account of clothing becoming caught, and also to prevent injuries which might be due to striking movable parts with material or tools.

Belts of Larger Size.—If located over passageways or places where employees work or congregate, such belts should have a structure extending the entire distance beneath the pulleys, of such material and construction as will prevent the belt, in case of breakage, from falling and striking the workmen.

Walkways for Oilers.—Where necessary to oil overhead machinery, a secure passageway with a railing on each side should be provided for the entire distance. In many shops no protection is afforded men whose duty it is to oil overhead machinery. They are required to crawl along beams, narrow planks unsecured, and, in some cases, to crawl between fast moving belts where a slight misstep or slip might cause them to be caught and crushed to death.

Emery Wheels.—The greatest trouble with emery wheels is not in their breaking, although this does happen occasionally and sometimes results in serious injury. More trouble arises from flying particles of dust thrown off which frequently cause injuries to the eyes of operators. Such injuries, it is true, are generally not serious, but they are annoying and cause considerable loss of time. Protection can be afforded against injuries by breakage by means of a guard extending entirely around the rim surface of the wheel, except the necessary grinding surface above the rest. The guard should be made of boiler plate or material of equal strength. Enclosure of the sides of

the wheels is not, as a rule, necessary since it has been found by experience that when the wheel breaks the pieces do not ordinarily fly to the side with sufficient force to cause injury. Protection from flying particles can be afforded to a considerable extent by attaching to the guard a glass shield extending over the rest.

The breaking of emery wheels is, perhaps, more often due to material becoming wedged between the rest and the rim of the wheel than to any other one cause. For this reason, great care should be taken to see that the rest is kept as closely adjusted to the rim of the wheel as possible. The Norton Company, Worcester, Mass., has given considerable attention to this subject and has incorporated its experiences in an interesting and valuable illustrated pamphlet entitled "Protection for Grinding Wheels," a copy of which, all who are interested would do well to procure.

As a general rule sufficient scrap material can be found about the average shop for the construction of necessary safeguards and, where possible to construct the guards in the shops, it is much preferable to buying them, for the reason that "home made" guards ordinarily serve the purpose better on account of being constructed for the particular machines to which they are applied and employees are likely to be more interested in guards which they construct themselves than in those which the company buys.

INSUFFICIENT LIGHT.

Injuries are often indirectly due to insufficient light. But few of our shops are lighted as they should be. The efficiency of the lights is greatly impaired in many shops by a failure to keep them properly cleaned and maintained. The fact that dirt and soot rapidly accumulate on the globes, it would seem, is permitted to serve as an excuse for not cleaning the lights frequently, whereas it is just the reason that this should be done. In every shop or roundhouse of consequence some one should be designated to clean and attend all lights at least every other day. Electric lights, of course, are the most satisfactory, and the tungsten style of lamp has been found to give the best results. Natural light, especially in new shops, can generally be provided by means of windows and sky-lights. These should be kept cleaned regularly and frequently.

Closely related to light is that of ventilation, which should always be provided for by special overhead construction, especially in blacksmith shops, grinding rooms and similar places. No forge or hearth should be operated without a hood of ample size discharging outside of the building.

FLYING PARTICLES.

Many eye injuries of a serious nature are due to pieces of metal thrown off in chipping or grinding. These injuries can be largely prevented by providing employees in this branch of the service with goggles. Those used by men engaged in chipping should be made of thick glass; for grinders, an ordinary cheap style of goggle which can be purchased for about five cents each, or less, will serve the purpose.

It is often urged by those who oppose the use of goggles that employees will not wear them. Some weeks ago we distributed to employees in the principal shops of the New York Central Lines who have occasion to do grinding or chipping a supply of goggles with a request that they give them a trial. We have just received reports to the effect that employees very generally volunteer to use them and express themselves to the effect that the goggle is a "good thing." We are, therefore, arranging to supply every man, whose duties require him to do metal chipping, with a pair of goggles especially constructed to afford protection from this source. We have decided to use the goggle known as the Julius King No. 1021-3040, which is the goggle adopted by the International Harvester Company and by many of the plants of the United States Steel Corporation, both of which concerns, we are reliably informed, tried and tested many different styles before deciding to adopt this particular make.

We are arranging to provide employees using grinding wheels with the ordinary style of goggles above referred to. It is not our intention to compel employees to use these goggles, except so far as we may be able to do so by arousing their desire to co-operate in the matter and, from our experience thus far, we feel that they will be quite generally used.

OBSTRUCTION OF PASSAGEWAYS.

One of the most prolific, as well as unnecessary, sources of injury to employees in shops and roundhouses is the obstruction of aisles and passageways by tools, rubbish and materials. Positive instructions should be issued and enforced in every shop requiring all employees to keep passageways clear. Any one who has made frequent inspections of shops will realize the necessity for this. Not only does the obstruction of aisles and passageways present a probable cause of injury, but it greatly interferes with the proper movements of employees, and thereby decreases their efficiency. It requires practically no effort or expense to keep aisles and passageways clear; it is simply a matter of habit. A shop, like an office or residence, can be kept in a disorderly and untidy condition, or in an orderly and proper condition, depending upon the one in charge. It ordinarily requires but little time to get employees in the habit of storing tools, material and rubbish in the proper places and in a proper manner. In one shop I know of the passageways are clearly indicated by white lines painted on the floors. Employees are required to keep the space between these lines entirely clear of obstructions. As a rule, however, I doubt if it is necessary to indicate the passageways by means of lines, or otherwise, as their limits are generally well understood.

FOREMEN IN CHARGE.

The prevention of accidents in shops and roundhouses depends, to a considerable extent, upon the foreman. If he is impressed with the importance of accident prevention and is personally interested in the subject, he will find numerous means of preventing injuries which could not otherwise be effected. Therefore, those who are in charge of safety movements will do well to convert, if necessary, the foremen and those in immediate charge to the cause of safety. There should, in fact, be fewer injuries in proportion to the number of men employed in shops and roundhouses than in any other branch of railroad service for the reason that the foreman has his men congregated in a very limited area where he knows them personally and is constantly in contact with them. In other words, he can, if he will, see and know just what the employees in the ranks are doing or not doing to make their work safe. As is the foreman, so will be the employee. Therefore, general officers in charge of shops should impress upon those in immediate charge of men that they will be held personally responsible for every case of injury in their jurisdiction which could have been prevented by ordinary prudence and vigilance.

Following are some of the precautions which employees in shops and enginehouses should observe:

Don't wear loose, baggy clothing in working around moving machinery.

Don't walk on railway tracks, and before crossing any track, "Stop, Look and Listen."

Report all unsafe conditions and practices to the foreman in charge or other proper person.

Explain fully to your helper the proper methods of work. A little time spent by a mechanic in imparing instructions to his helper may save one or both an injury.

Never jump on moving cars or engines. This is a risk which no shopman is required to take and which he cannot afford to take.

Never strike tempered steel with a hammer or metal object.

Stop machines before oiling, wiping or repairing. In shops of the New York Central Lines we have attached to every machine, the nature of which makes it at all necessary, a metallic sign reading "Stop This Machine Before Repairing, Oiling or Wiping."

Foremen should be required personally to give every employee entering the service full and complete instructions concerning the safe methods of doing the work to which he is assigned. They should require employees, and enforce the requirement by discipline if necessary, to keep all safeguards in proper position, and especially should investigate carefully all cases of injury in their jurisdiction with a view of avoiding a recurrence. After all, eternal vigilance is the price of safety.

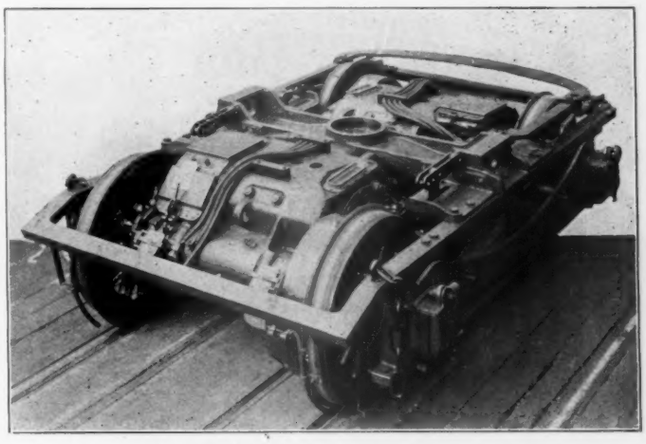
ELECTRIC LOCOMOTIVES FOR THE SOUTHERN PACIFIC

Fifteen electric locomotives are being delivered to the Southern Pacific for use on its Pacific coast properties in freight and switching service. Twelve of them are equipped for operation on either 600 or 1,200 volt direct current lines, and three are arranged for 600 or 1,500 volt operation. The mechanical parts were built by the Baldwin Locomotive Works and the electrical equipment was constructed and installed by the Westinghouse Electric & Manufacturing Company.

While designed primarily for freight service, these locomotives may also be used for passenger trains if desired. With natural ventilation the motors and auxiliary apparatus on each locomotive have sufficient capacity to give a continuous tractive effort of 5,600 lbs. With the blowers in operation, the locomotive will exert continuously a tractive effort of 11,520 lbs. and a pull of 21,600 lbs., at a speed of 17.6 miles per hour, can be obtained for a period of one hour with 600 volts at the motors. A momentary tractive effort of 30,000 lbs. can be exerted when on clean, dry rails.

Each locomotive has four motors, each having a normal rating of 225 horsepower with natural ventilation and 250 horsepower with forced ventilation at 600 volts. Each motor is geared to the axle and their location and arrangement on the truck is shown in one of the illustrations.

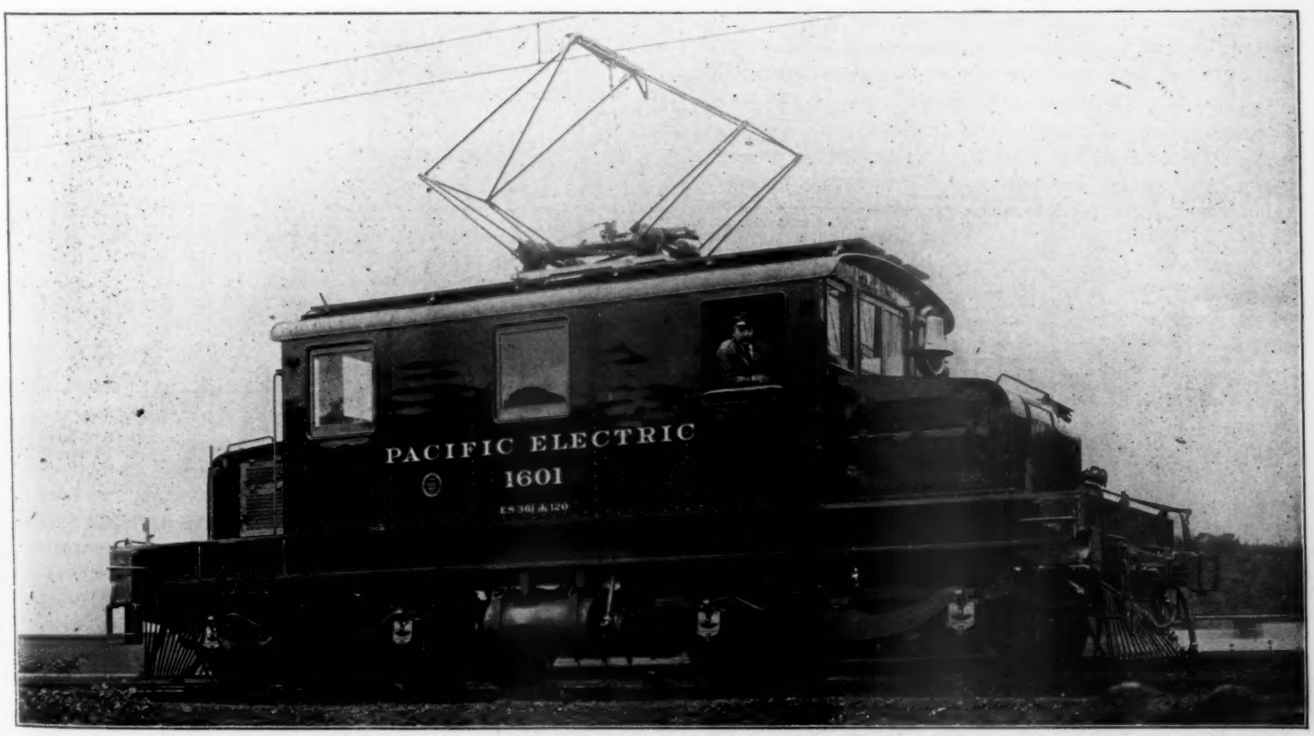
The trucks are of the equalized pedestal type with one-piece rectangular frames. The pedestals are protected by shoes. The wheels are 36½ in. in diameter, have cast steel centers and tires held in place by bolted fastenings. The journals are 5½ in. x 10 in. Four 13 in. channels 30 ft. in length form the longitudinal members of the underframe. These connect heavy cast iron end sills and are stiffened and braced by flanged



Truck for Southern Pacific Electric Locomotive.

diaphragms and the heavy steel floor. The body bolsters consist of plates 15 in. wide and 1½ in. thick continuous across the bottom of the channels. The center plate is secured directly to this plate bolster. Steel plates, ½ in. thick, cover the entire underframe, and are riveted to all of the longitudinal sills and to the braces. Above these there is a ¼ in. diamond plated steel flooring.

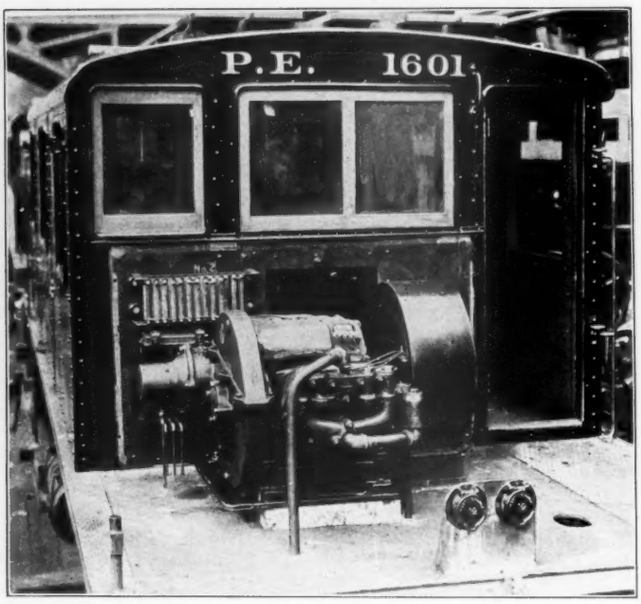
The centrally located steel cab measures 18 ft. in length by 9 ft. 6 in. in width. The entrance is through end doors at diagonally opposite corners, the hoods at either end of the cab



Electric Locomotive for the Southern Pacific.

being placed off center to give a passageway from the ends of the locomotive to the doors. The locomotives are equipped throughout in accordance with standard railway practice and have M. C. B. couplers, steel pilots, safety appliances, etc.

Three running positions are provided on the controller for 600 volts and two for either 1,200 volts or 1,500 volts. A pneumatically operated series-parallel switch gives the proper connections for the running positions, and is operated by a control switch from either end of the cab. It is so designed



End Hood Removed Showing Dynamotor and Air Compressor.

that the two motors comprising each pair may be connected in series or parallel with each other at the will of the operator. An interlocking arrangement has been provided that makes it impossible to operate the series-parallel switch except when the circuit on the main motor is opened.

There are eleven notches on the master controller with the motors in full series; nine notches with the motors in series-parallel, and nine with the motors in full parallel. On 1,200 or 1,500 volts the motors are operated only in full series and in series-parallel. When it is desired to operate on 1,200 volts, two hand-operated drum type switches are employed which simultaneously readjust the divisions in the main resistance and lock the series-parallel switch in the series position. The same number of notches are then available on the master controller for 1,200 volt operation as for 600 volt operation for the full series or the series-parallel position. Each locomotive is equipped with train line receptacles and jumpers and any number of units can be controlled by one operator.

A relay has been provided which will open all the circuits of the motors whenever the trolley passes a specially arranged aerial brush contactor. This insures an open circuit through the motors when the trolley passes a section insulator. It is necessary to bring the master controller to the "off" position before the relay can be reset. An over-speed relay is also provided.

Two dynamotors are installed under the hoods, one at either end of the locomotive, and operate the air compressors for the brakes as well as the fans for forced ventilation of the motors. These dynamotors run constantly and drive the air compressors, which have a displacement capacity of approximately 50 cu. ft. of free air per minute, by a pneumatically operated friction clutch that is controlled by the main reservoir pressure. The fan for forced ventilation is mounted on the extended shaft of the dynamotor and runs continuously. These fans serve as a light load to limit the speed of the dynamotors when the air compressors are not in use. Each dynamotor has two sets of armature and field windings both mounted in the same slots and on the same poles. When the locomotive is operated on 1,200 volts the two windings are connected in series and the current for the lights and control apparatus is tapped midway between the two, providing a voltage of 600. When operating on a 600 volt line circuit, one set of armature and field coils is cut out and the remaining set operates as in a series motor.

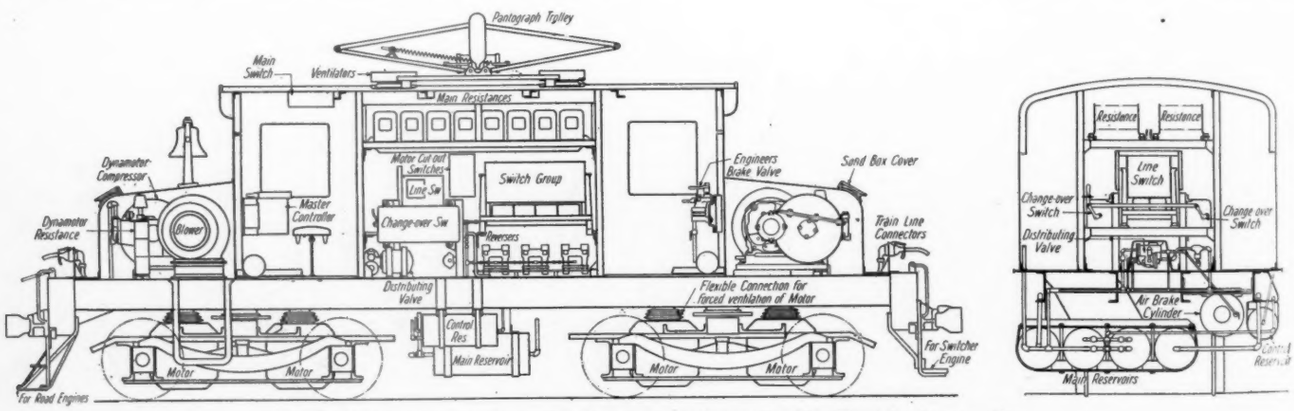
Some of the principal dimensions of these locomotives are as follows:

Rigid wheel base	7 ft. 4 in.
Total wheel base	25 ft.
Distance between truck centers	17 ft. 8 in.
Driving wheels, diameter	36½ in.
Journals	5½ in. x 10 in.
Width over all	10 ft.
Height to top of cab	11 ft. 5½ in.
Weight, total	120,000 lbs.

A CORRECTION

In the description of a pneumatic clamp for testing triple valves on page 522 of the October issue, the chamber for the piston was given as 4 in. in diameter by 6 in. deep. This should have been 6 in. in diameter by 4 in. deep.

Coal for Belgian Railways.—It is proposed to introduce a bill in the Belgian chamber to approve the agreement which has recently been concluded in connection with the decision to reserve for home uses all future orders of coal from the Belgian state railways. According to the agreement the Belgian collieries will have to supply all the coal required by the railway's administration at a rate per ton based on the price fixed by the mining administration. Only small orders for special coal will be placed outside of Belgium.



General Arrangement of Apparatus on Southern Pacific Electric Locomotive.

REDUCING SMOKE ON SWITCH ENGINES

D. R. MacBain, superintendent of motive power of the Lake Shore & Michigan Southern, presented a paper before a meeting of the International Association for the Prevention of Smoke at Indianapolis, Ind., on September 25, 1912, in which he discussed smoke elimination on switch engines. Parts of this paper are given below:

Without attempting to place them in the order of their importance, the things that are necessary to successfully avoid the emission of smoke on hand-fired terminal power are: A boiler and

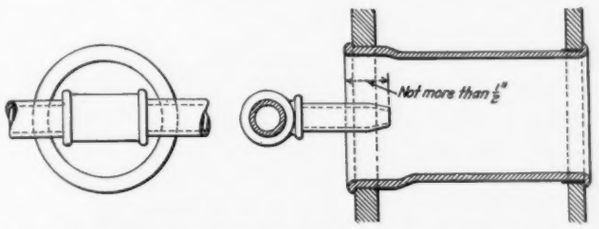


Fig. 1—Arrangement of Steam Jets Through the Water Legs.

firebox in as nearly perfect condition as possible; careful, intelligent and vigilant effort on the part of the engine crew; proper care of boiler appurtenances; a good blower of sufficient size; the steam jet arrangement for the introduction of sufficient quantities of air over the top of the fire, when needed; a suitably designed brick arch properly installed and maintained; good drafting of the locomotive so that forcing the fire will be unnecessary; a well proportioned superheater; the proper cleaning of smoke emitted from engines being fired up at engine houses.

The utilization of any one of the above will accomplish something in the way of smoke elimination, but the use of all of them combined will result in work very close to the 100 per cent.

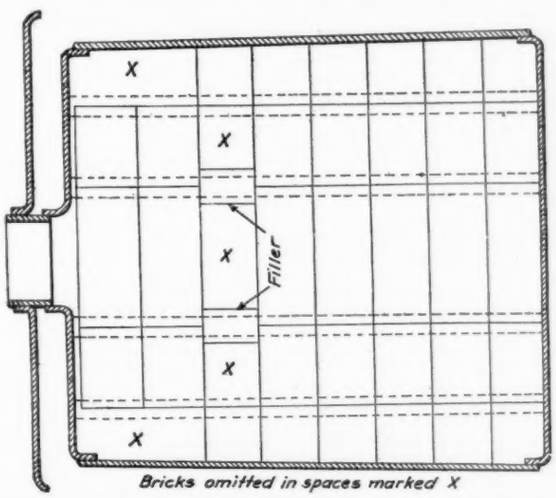


Fig. 2—Recommended Arrangement of Brick Arch in Switch Engines.

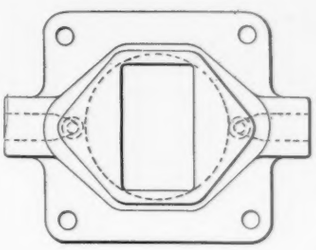
mark at all times, even with the use of the most highly volatile fuels.

The flues should be kept tight and clean at all times, and the openings in the grates should be kept open. The grate operating rigging should be kept in good condition so as to be easily operated, and so that the grates can be shaken often enough to admit of the proper admission of air through the fire at all times.

A good blower is necessary and an operating valve on each side of the cab within convenient reach of both engineer and fireman is most desirable, in order that either may start the blower quickly in case of necessity.

The use of the steam jets in the firebox in connection with the blower, as an aid in the prevention of smoke, is essential, as, if the jets are used without the blower, sparks may be blown back in the cab. Fig. 1 illustrates the manner in which the steam jets should be arranged. It will be noted that the jets should not enter the outside of the air tube more than ½ in., and it has been demonstrated that 40 or 50 lbs. steam pressure is ample for their use. That pressure will suffice to develop all the benefit that can be derived from the use of the steam jets, and the noise incidental to their use will be much reduced and rendered less objectionable. It is therefore advisable to apply a steam reducing valve in the line between the throttle and the jets. The steam jets drive the currents of cold air closely over the surface of the fire in such a manner as to cause an intermingling with the escaping gases and thus aid in their combustion. A good job of smoke prevention can be accomplished with the blower and steam jets in combination, provided the engine crew is properly instructed and that conscientious and intelligent use is made of them.

The next essential in securing the best results is a suitably designed brick arch, the installation of which on power doing work of an intermittent nature, such as on switch engines, where long continued service is not necessary, should be about as shown in Fig. 2. The spaces marked X are the only open-



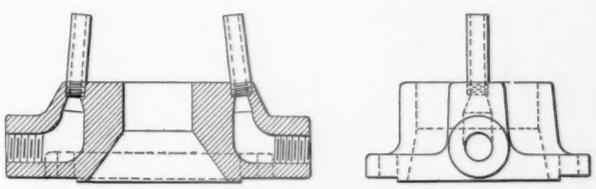


Fig. 3—Rectangular Nozzle Used on the Lake Shore.

ings through the arch. The arch, acting as a baffle wall, produces an even flow of the gases of a uniform temperature, and by reason of the fact that the arch is incandescent and the gases are compelled to travel a greater distance before reaching the flues, combustion is materially improved and smoke emission is reduced correspondingly.

In drafting a locomotive so that it will generate steam as freely as possible, and at the same time obviate the necessity of crowding the fire, there are a number of points that ought not to be lost sight of. There should be some arrangement whereby there will always be not less than one-eighth of the door area open and unobstructed for the admission of air over the top of the fire, whether the engine is standing or working. The opening under the diaphragm should be not less than four-fifths of the total flue area. The diameter of the smoke-stack should be not smaller than four times the diameter of the nozzle, if the nozzle is round. I do not, however, recommend a round nozzle, as the rectangular nozzle, shown in Fig. 3, has proved superior to it.

The reasons for referring to the nozzles and smoke-stack in connection with the elimination of smoke are that easy egress to the atmosphere of the steam jet from the exhaust and the gases entrained thereby is essential. The ideal condition is to have the steam jet from the exhaust nozzle pass out through the center of the smoke-stack, without coming in contact with the walls of it at any point. The jet should pass out with a

liberal clearance all around so that the gases may be entrained properly and carried out to the atmosphere without interference, as shown in Fig. 4. Unless the foregoing conditions are observed and provided for, the exhaust in ascending will have a sidewise tendency. The effect of this will be that the steam jet from the nozzle will scour up the side of the smoke-stack, and in doing so the entrained gases will be scraped off, so to speak, interfering materially with the draft on the fire, and invariably resulting in a smaller nozzle being used than is necessary, to increase the velocity of the jet to get the required number of cubic feet of gases for each cylinder full of steam that is used.

The smoke-stack should not be longer than is necessary to carry the gases over the top of the cab, in which case, if the stack is not too small in diameter, the steam jet from the nozzle will not expand sufficiently to fill the stack at the top. The rectangular nozzle having the long dimension parallel with the longitudinal axis of the engine, will re-shape the steam jet after it leaves the saddle, and consequently it will not pass out angularly and strike the side of the stack: it also insures a full entraining area around the whole circumference of the jet, re-

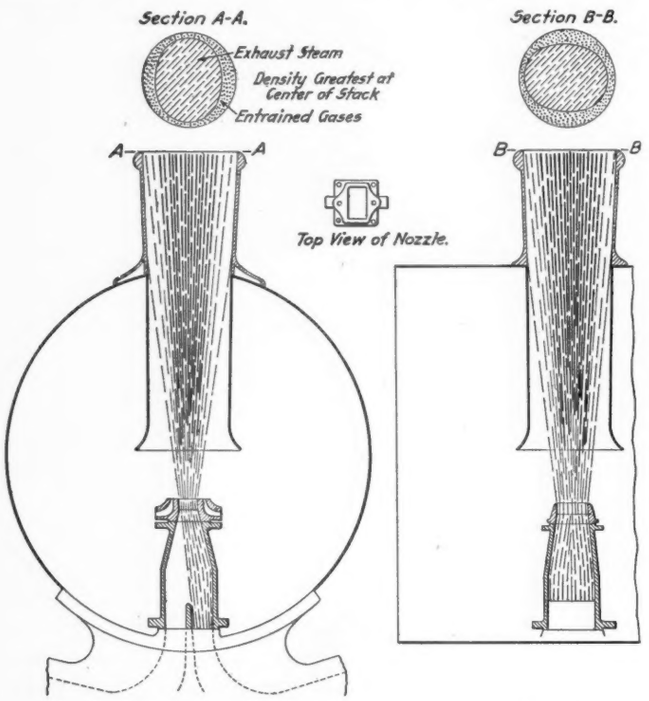


Fig. 4—Action of Exhaust Steam with Rectangular Nozzle.

sulting in easy steam generation, which is a most important function in the elimination of smoke.

The final step in the accomplishment of smoke prevention lies in the application of a superheater. A superheater of the proper size installed in a switching engine reduces the consumption of coal and water approximately 40 per cent., and therefore it necessarily follows that the emission of smoke will be correspondingly reduced.

To stop the emission of smoke from the stacks of cold locomotives that are being fired up in engine houses, is a task not easy of accomplishment: in fact, to our knowledge, no means have been developed that will cope with this feature, and consequently the next important and necessary move is to provide some method of taking care of the smoke thus made; viz., cleaning it to a point that will render it unobjectionable before it is turned out to the atmosphere.

Suez Canal Traffic.—During August 409 ships passed through the Suez Canal as compared with 364 ships in August, 1911, and 337 ships in August, 1910.

DESIGNING VOLUTE SPRINGS

BY H. C. WEAVER,
Chief Draftsman, San Pedro, Los Angeles & Salt Lake, Los Angeles, Cal.

In comparison with other types of springs, the volute is not very extensively used, although it is a very efficient form and is capable of satisfying a variety of conditions. This can be attributed in most cases to the difficulties encountered in its manufacture, and these difficulties in turn can be attributed to discrepancies and errors in design.

Although the general principles of its design are very simple, unless care be taken in certain of the details—principally in

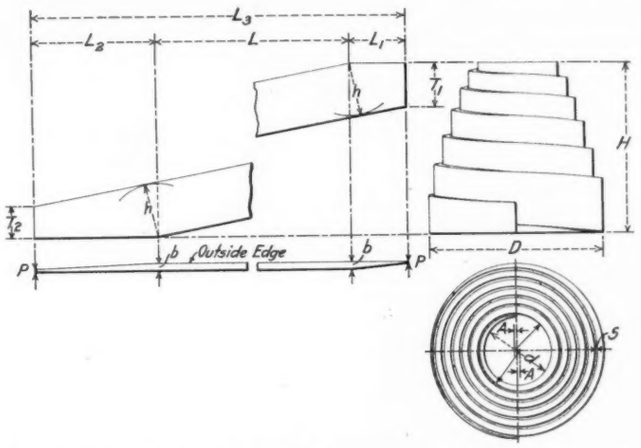


Fig. 1—Volute Spring With Flat Base and Top Equal to ¾ of the Circumference.

calculating the exact length and shape of the bar and in determining the effective leverages of the coils—the results will not be satisfactory. The following directions and formulas, if carefully followed and applied, will eliminate the possibility of errors to a great extent.

The three dimensions which generally limit the design of the spring are the inside diameter, the outside diameter, and the height. Having these three dimensions given, the main point is to utilize all the available space and to calculate the exact length and shape of a bar which, when coiled, will ex-

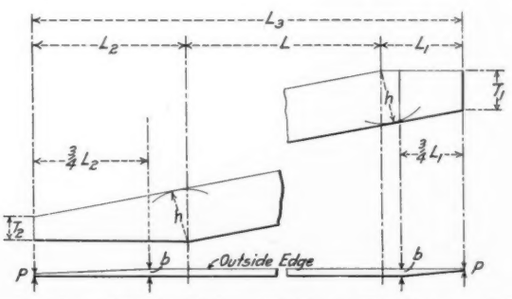


Fig. 2—Bar for a Volute Spring, Having a Flat Base and Top on the Full Circumference.

actly fill this space, and at the same time keep the outside and inside coils or boundary circles of the spring concentric.

In the diagrams and formulas:

D = the outside diameter of the spring.
d = the inside diameter of the spring.
H = height of the spring, after test.
H_1 = height of the spring, before test.
b = thickness of the bar.
h = width or depth of the bar.
A = offset of the radius centers of the coils.
L = length of bar exclusive of tapers.
L_1 = length of inside taper (¾ of a complete circle in length).
L_2 = length of outside taper (¾ of a complete circle in length).

L_s = total length of the tapered bar.
P = thickness of the tips or ends of the tapers.
T_1 = width of the tip or end of the inside taper.
T_2 = width of the tip or end of the outside taper.
S = uniform clearance between coils throughout from tip to tip (varies from 1/32 in. to 1/16 in. for bar ⅛ in. to ½ in. in thickness).
D_1 = mean effective diameter of the smallest coil.
D_n = mean effective diameter of the n^{th} coil.
(All of the above dimensions are to be expressed in inches.)
N = number of coils (not including tapers).
G = modulus of elasticity of steel in torsion = 12,600,000.
W = maximum capacity of spring in pounds.
f = maximum permissible fibre stress of the spring in lbs. per sq. inch (60,000 for buffer springs and 80,000 for carrying springs).
δ_1 = the deflection in inches of the smallest coil, under the load W.

For computing each desired dimension, the following formulas can be used. Figure 1 shows the bar, and the completed spring with the reference letters as used in this case:

$$n = \frac{D - (d + 2b)}{2(b + s)}$$

$$D = 2n(b + s) + (d + 2b)$$

$$L = n\pi\left(\frac{D + d}{2}\right)$$

$$L_1 = \frac{3\pi}{4}\left(d + \frac{b}{2} - \frac{s}{4}\right)$$

$$L_2 = \frac{3\pi}{4}\left(D - \frac{b}{2} + \frac{s}{4}\right)$$

$$L_s = \frac{\pi}{4}\left[(2n + 3)(D + d)\right]$$

$$P = \frac{b - 3s}{4}$$

$$T_1 = h - \frac{\delta_1 L_1}{\pi D_1}$$

$$T_2 = h - \frac{\delta_1 L_2}{\pi D_1}$$

$$A = \frac{b + s}{4}$$

$$D_n = d + 2nb + (2n - 1)s$$

$$W = \frac{2 f b^2 h^2}{3 D_1 \sqrt{b^2 + h^2}}$$

$$\delta_1 = \frac{\pi f \sqrt{b^2 + h^2}}{2 G b h} D_1^2$$

$$H = \frac{L\delta_1}{\pi D_1} + h$$

$$H_1 = 1.1\frac{L\delta_1}{\pi D_1} + h$$

It is the practice among some makers to use a top and bottom taper equal to a complete circle in length and a lateral taper only ¾ of a complete circle in length as shown in Fig. 2. In this case the notation and formulas are the same as those above with the exception of the following:

$$n = \frac{D - (d + 3b + s)}{2(b + s)}$$

$$D = (2n + 1)(b + s) + (d + 2b)$$

$$L_1 = \pi\left(d + \frac{13b}{16} - \frac{3s}{16}\right)$$

$$L_2 = \pi\left(D - \frac{13b}{16} + \frac{3s}{16}\right)$$

$$L_s = \frac{\pi}{2}\left[(n + 2)(D + d)\right]$$

$$D_n = d + \left(\frac{4n + 1}{2}\right)\left(b + \frac{4n - 1}{2}\right)s$$

Actual practice has demonstrated that a taper of ¾ of a complete circle in length affords ample stability as a seat or base to a spring; so that in making the tapers a complete circle in length, that much useful space is being wasted, and for a given inside diameter the maximum capacity is accordingly reduced.

PAINT SHOP KINKS

BY T. J. HUTCHINSON,
Foreman Painter, Grand Trunk, London. Ont.

REVOLVING TABLE FOR PAINTING.

The table shown in Fig 1 is provided with a swivel top and is used for painting, graining and varnishing sash, cleaning glass and painting water coolers. The sash or article placed thereon may be turned easily without having to be lifted. The castings are such as are generally used on parlor car chairs. The lower one is screwed to a heavy oak turned base and the top one to a

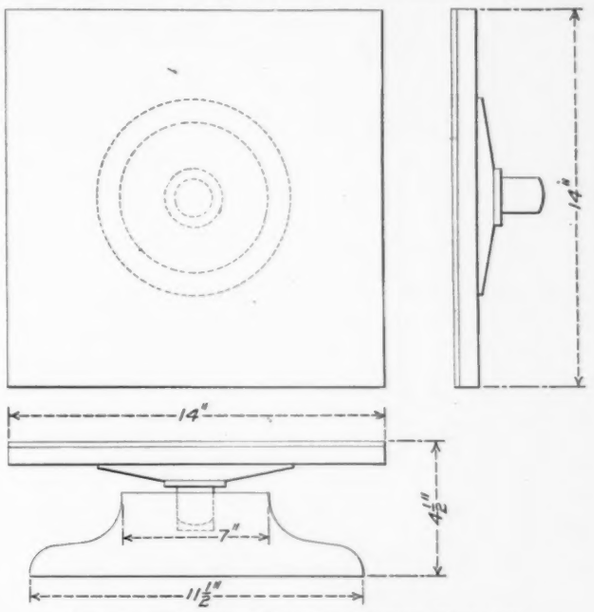


Fig. 1—Revolving Table for Painting Sash, etc.

block 14 in. square, the upper side of which is covered with rubber. Our pieceworkers find that this device greatly facilitates their work. Old parlor car chair swivels can be obtained from scrap and the initial cost of the device is next to nothing. When once this arrangement is used it will be found to be indispensable.

PAINTERS' DUSTER RACK.

The duster rack shown in Fig. 2 was devised to enable our stockman to keep track of the brushes without having to give

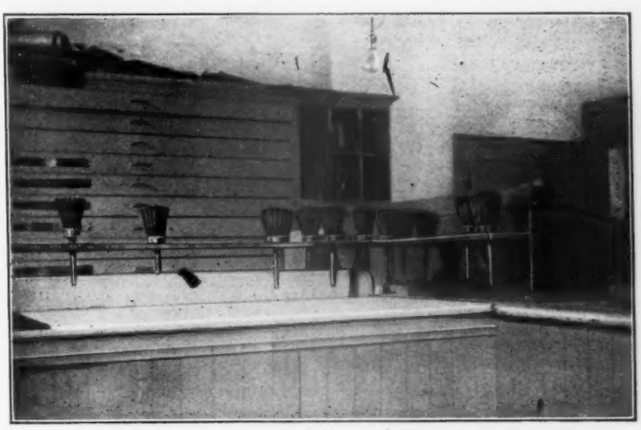


Fig. 2—Rack for Holding Painter's Dust Brushes.

too much of his time to it. The rack is a shelf supported on brackets and placed conveniently near the stockman's desk, with holes bored for the number of brushes required, each workman's check number being stamped on the duster and rack alike. Each day these dusters are returned to this rack, where the stock-

man can see at a glance if any are missing. The month previous to the introduction of this rack over a dozen dusters were lost; since then we have had no trouble of this kind.

STENCIL WASHING RACK.

To clean and care for railway car stencils expeditiously and economically became an important matter when piecework was introduced. The rack which is shown in Fig. 3 aids us greatly in this work. It is 5 ft. high with a trough and shelf below, the entire face of which is covered with sheet zinc. The top

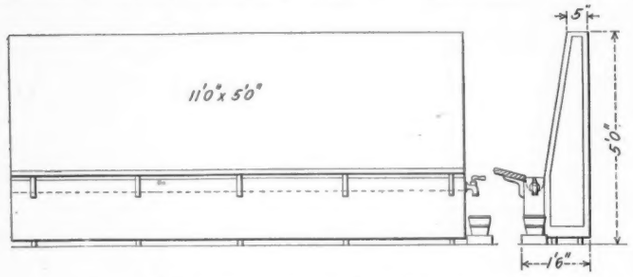


Fig. 3—Rack for Washing Stencils.

slopes to the rear, and enables a liberal use of benzine in cleaning, which is caught in the trough and runs into the pail at the end of the rack, from which it can be used again. By the use of the faucet the benzine can be retained in the trough until the work is completed, if so desired.

COACH DOOR RACK.

Railway coach doors receive more abuse in service than any other part of the interior fittings. Therefore they require greater varnish protection. We find that this can be attained most effectually when the doors, after being varnished, can be placed flat-

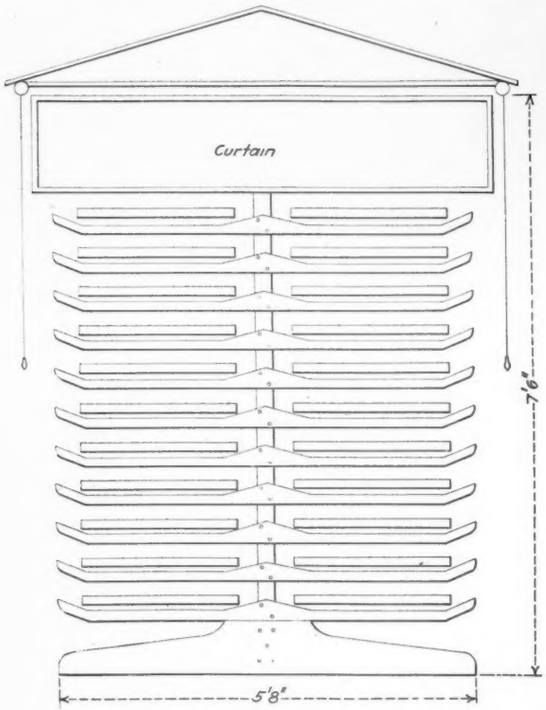


Fig. 4—Rack for Storing Coach Doors.

wise while drying. The dimensions of the rack shown in Fig. 4 are 5 ft. 8 in. wide, 6 ft. 6 in. long and 7 ft. 6 in. over-all in height. It is enclosed with four spring roller shades to protect the varnished work from the dust, and is made of two upright posts, securely bolted to a heavy base wide enough to support the upper structure. To each of the two posts 13 arms or brackets are secured. These brackets are so shaped that only the extreme edges of the doors touch them when placed in the drying position.

CARBOYS FOR PAINT VEHICLE.

A systematic way of preparing the vehicle used for priming and surfacer coats for new and burnt off work must commend itself to the practical painter. The three carboys shown in Fig. 5 contain the paint vehicle for the priming and surfacer coats; each carboy holds about fifteen gallons and is air-tight, thus preventing the contents from getting fat. The oil, turpentine and japan are mixed in proper proportions for the coats, put into the carboys and drawn off by syphon as required. This arrangement prevents mistakes by the stockman and uniform results are assured. J. W. Davidson, chemist of the Chicago & North Western, introduced the use of the carboy and syphon system for this purpose.

LONG-HANDLED BRUSH FOR FREIGHT CARS.

One of the most economical kinks in painting railway freight cars is the use of the long-handled brush. When this method was introduced on our road, I had a local brush manufacturer make a brush similar to the ordinary whitewash brush, but having double the stock securely bound with brass instead of

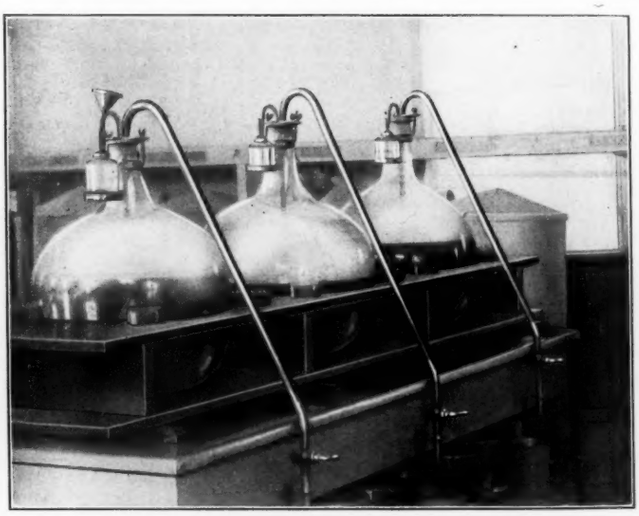


Fig. 5—Carboys for Holding Paint Vehicle.

the usual leather binding, the handle being of sufficient length to reach the top of the highest box car. With the short-handled brush still used on some lines, much time is taken up in erecting and handling the necessary staging, but in using this brush no staging of any kind is required and the time formerly needed for coating has been reduced fully one-half.

Dead Weight of Vehicles Per Passenger.—"In looking back on the history of transportation we find that a horse-drawn carriage will weigh about 1,500 lbs. to 2,500 lbs., seating, on an average, four passengers and a driver, which gives a dead weight per passenger of from 300 lbs. to 500 lbs. This vehicle will move at a speed of 6 miles to 8 miles an hour over a roadbed not comparable to the worst kind of railway track. An automobile weighing 5 tons, seating 7 passengers and containing its own power plant, moving with almost the same average speed as a passenger train over a far inferior roadbed, gives a dead weight per passenger of about 1,428 lbs. The dead weight per passenger of a steel railway coach amounts to from 1,200 to 1,700 lbs., and, permitting the points of superior comfort and safety to be balanced by the poor roadbed and the weight of the power plant of automobiles we must ask the question: 'Is there no possibility of getting below the automobile limits of dead weight per passenger, and is this reduction possible without sacrificing safety and comfort?'"—*A. Copony before the Canadian Railway Club.*

POWERFUL 2-8-8-0 TYPE LOCOMOTIVE

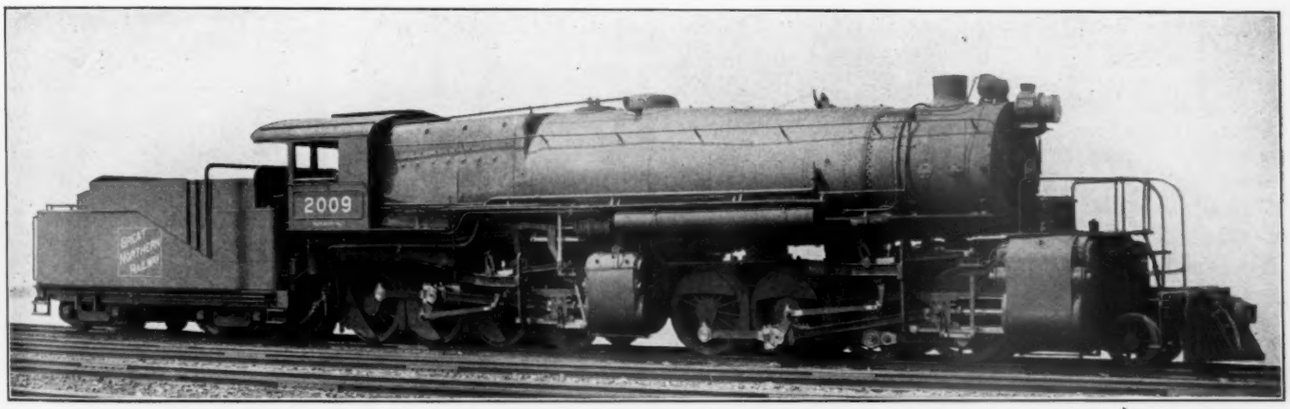
Has a Tractive Effort of 100,000 Lbs. Working Compound and a Device For Varying the Relation of the Point of Cut-Off in the Two Sets of Cylinders.

A tractive effort of 100,000 lbs. working compound, with 63 in. drivers, places the new locomotives recently delivered to the Great Northern by the Baldwin Locomotive Works among the most powerful on our records. They are also the first engines with this wheel arrangement, although this company has a number of Mallet locomotives of the 2-6-8-0 type in operation.

These locomotives form the fifth class of Mallets in use on the Great Northern. The first engines of the type were purchased in 1906 for pusher service. They are of the 2-6-6-2 type, have 21½ in. and 33 in. x 32 in. cylinders, 55 in. drivers and a tractive effort of 71,600 lbs. The total weight is 355,000 lbs. with 316,000 lbs. on the drivers.* In the following year some locomotives of the same wheel arrangement, but designed for regular road service, were purchased. These have 20 in. and 31 in. x 30 in. cylinders, 55 in. drivers, a tractive effort of 57,940 lbs.; a steam pressure of 210 lbs. and a total weight of 302,650 lbs., of which 263,350 is on drivers.† The third class, of the 2-6-8-0 type, were built in 1910. These have 23 in. and 35 in. x 32 in. cylinders, 55 in. drivers and a tractive effort of 82,000 lbs. They are fitted with Emerson superheaters, giving 480 sq. ft. of heating surface, and have feed water heaters incorporated in the front sections of the boilers. They have a total weight of 378,300 lbs., of which 359,600 lbs. is on drivers.‡ In 1910 this company also converted some consolidation locomotives to Mallets by the addition of a new front unit which gave a locomotive of the 2-6-8-0 type. There is a feed water heater in the new front section, and a superheater was applied in the old boiler.§

The locomotives just received are considerably larger than any of the previous classes. They have a total weight of 450,000 lbs., of which 420,000 lbs. is on drivers. The cylinders are 28 in. and 42 in. x 32 in. The steam pressure has been raised to 210 lbs. while the diameter of the drivers has been increased from 55 in., which has been standard on previous Mallets on this road, to 63 in. The theoretical tractive effort working compound is 36 per cent. larger than that of the engines purchased in 1910 and 55 per cent. larger than the pusher engines purchased in 1906.

In comparison with other large Mallet locomotives, the new Great Northern engines rank sixth in regard to total weight and are a very close second to the record holders on the Virginian in respect to power. They are fitted with Emerson high degree superheaters which have 1,368 sq. ft. of surface measured on the inside of the tubes. This slightly exceeds the area of the superheaters on the Virginian engines, which are of the Schmidt type. In evaporative heating surface, the Great Northern engine is somewhat less both in the firebox and in the tubes than the Virginian, and the boiler is 10 in. less in diameter, both at the front ring and at the largest point. There is also considerable difference in the grate areas, which are 99.2 sq. ft. on the Virginian and 78.4 sq. ft. on the Great Northern. Eight of the twenty-five engines, however, are arranged for oil burning. It will be noted that no feed water heater is provided in the front part of this boiler, as was the case in the previous order. The tubes have been increased to 24 ft. in length and the remainder of the space has been incorporated in a very large combustion chamber which adds 81 sq. ft. to the firebox heating surface.



Mallet Locomotive Having a 100,000-Pound Tractive Effort When Working Compound; Great Northern.

In some cases it appears that the amount of power developed by the two groups on a Mallet locomotive varies with the variation in speed and in the point of cut-off in the high pressure cylinder. Since it is desirable that the work of the locomotive be equally divided between the two groups of wheels, an arrangement whereby the relative point of cut-off in the high and low pressure cylinders can be varied at the will of the engineman, has been applied to these locomotives. This result is accomplished by use of a slotted arm on the reverse shaft of the high pressure engine where it connects with the reach rod carried forward between the frames for operating the low pressure gear. The position of the block in the slotted arm is controlled by a screw gear in the cab and a change of 20 per cent. in the point of cut-off of the low pressure engine is permitted. The construction of this arrangement will be described later.

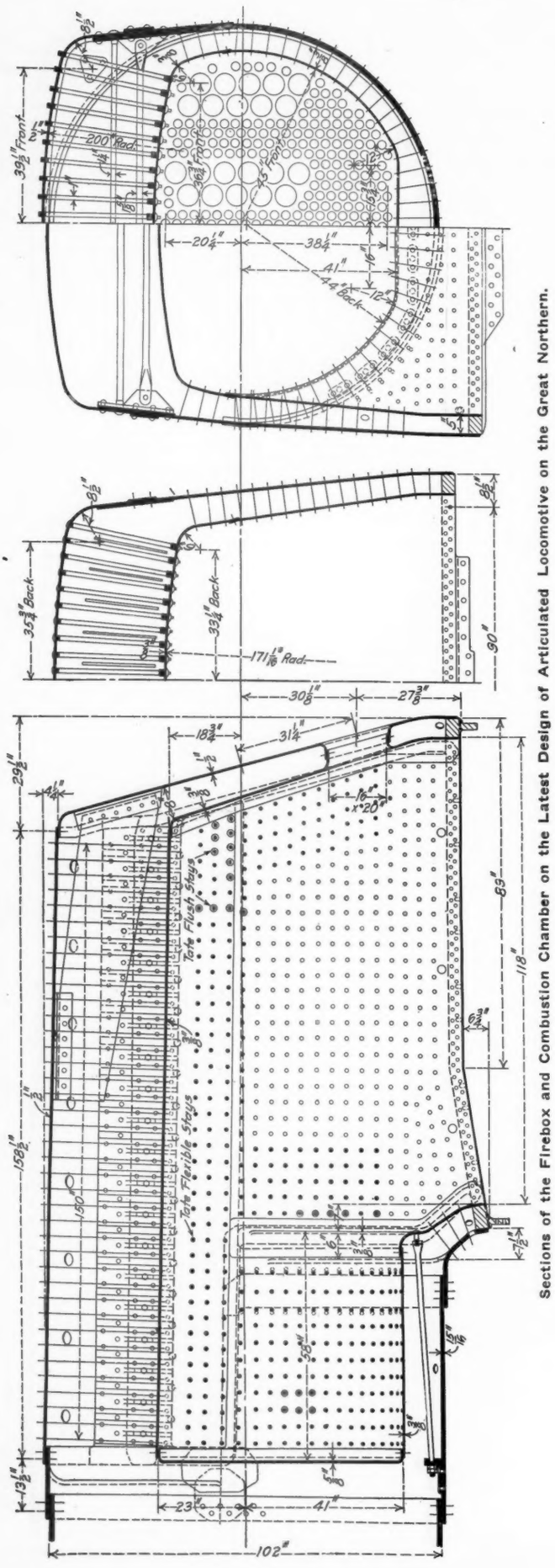
Boiler.—The boiler is of the Belpaire type, the square section being continued to the front end of the combustion chamber. The center barrel sheet is conical, increasing the diameter from 90 in. at the front end to 102 in. at the dome ring. In-as-much as the firebox is set over the top of two 63 in. driving wheels, the throat sheet is very shallow. In fact, the flat portion of the grate which extends forward from the back of the mudring for about 83½ in. is but slightly below the level of the bottom of the boiler barrel. At this point the grate slopes downward to the

* For illustrated description see *American Engineer & Railroad Journal*, October, 1906, page 371.

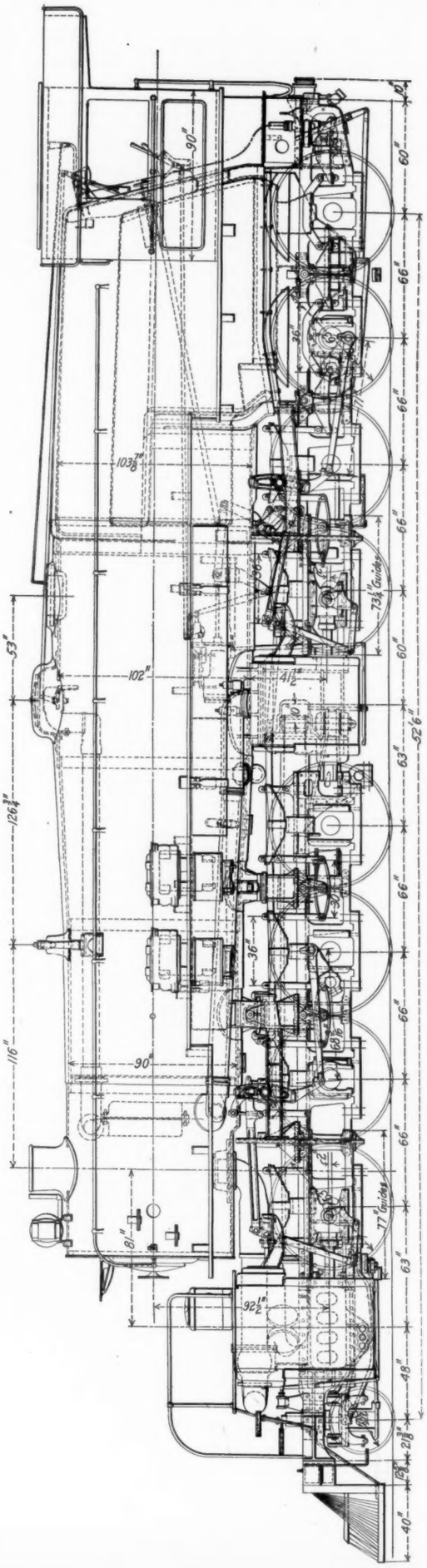
† For illustrated description see *American Engineer & Railroad Journal*, June, 1907, page 213.

‡ For illustrated description see *American Engineer & Railroad Journal*, August, 1910, page 308.

§ For illustrated description see *American Engineer & Railroad Journal*, October, 1910, page 399.

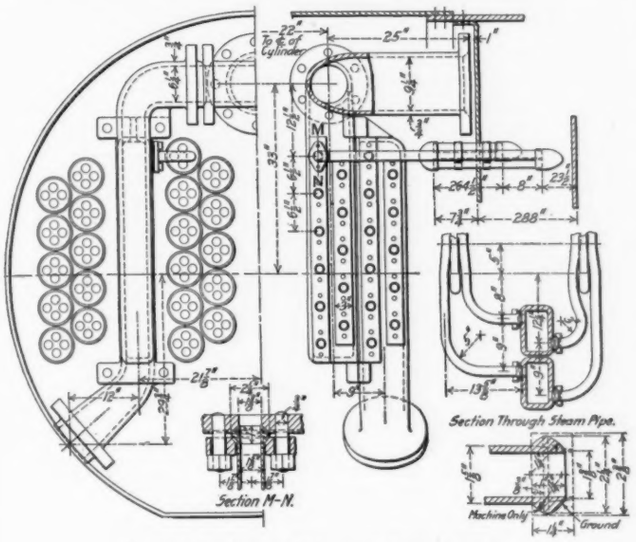


Sections of the Firebox and Combustion Chamber on the Latest Design of Articulated Locomotive on the Great Northern.



Mallet Locomotive Fitted With an Arrangement for Changing the Relative Point of Cut-off In the Two Sets of Cylinders.

front of the mudring, which is 6¾ in. below the back, giving a throat sheet only about 10 in. in depth. The combustion chamber is 58 in. in length and is flattened on its under side to give a clearance of 9⅝ in. from the boiler shell. The clearance on the sides is about 6 in. The crown sheet is continuous for the full length of the firebox and the combustion chamber and is carried by expansion bolts. Flexible stay bolts are freely used in the



Latest Design of Emerson Superheater.

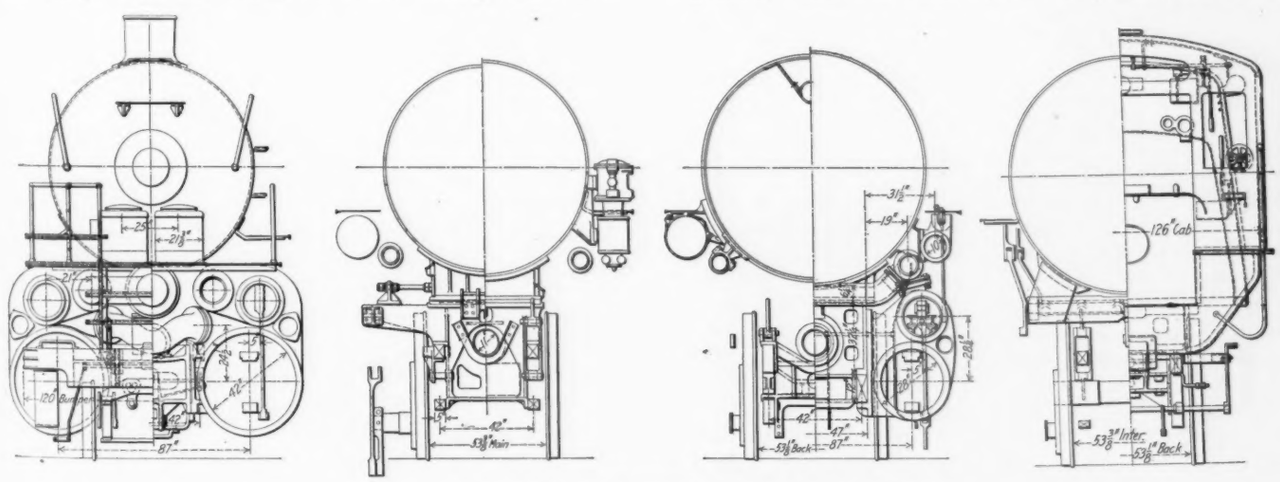
sides of the firebox and exclusively in the staying of the sides and bottom of the combustion chamber.

There are 332 boiler tubes of 2¼ in. diameter and 42 5½ in. boiler flues for the superheater elements. The arrangement of these is shown in one of the illustrations. The main dome has a height of 10½ in. and is formed of a single piece of flanged steel. Restricted clearance limits necessitated the mounting of the safety valves and whistle on a steel casting which is depressed in a 26 in. opening cut in the boiler shell just back of the main dome. The single firedoor measures 16 in. x 20 in. The grates on the seventeen coal burning locomotives are arranged to rock in four sections and have drop grates at the rear. In lieu of a brick arch of the usual type, a fire brick wall is built across at the back of the combustion chamber. This is 42 in. high, 9 in. thick and its front face is 42½ in. from the tube sheet.

In the superheater a new method of fastening the tubes to the header has been designed, which is somewhat similar to the construction on the Schmidt design. The saturated and superheated headers are cast separately and bolted together, there being one pair on either side of the front end, located as is shown in the illustration. The double looped elements connect to the headers on either side, and the pipes are bent at right angles and fitted with ball joints which seat directly on the sides of the header castings, being held in place by plates, each of which is secured by two studs. The elements extend back in the flues to a point of about 20 in. from the back flue sheet and give an area, measured on the inside of the pipes, of 1,368 sq. ft., making this the largest high degree superheater ever applied. The steam leaves the superheater headers by pipes through the side of the smoke-box, and the equalizer pipe, which in some previous designs has been connected to the headers, is, in this case, installed between the two outside steam pipes at a point just ahead of the cylinders.

Steam Piping.—The exhaust from the high pressure valves is carried through passages in the cylinder and saddle to a chamber directly above the articulated connection. Here is seated the ball joint of the receiver pipe. The cast steel ball is screwed and then welded by the acetylene process to the 11 in. receiver pipe. It is seated on two adjustable brass rings which are faced with babbitt and have a ring of packing material fitted between them. These rings are held in place by a packed gland. The receiver pipe is 24 ft. 5 in. long and at its forward end is slip-jointed to a cast steel Y connection, one branch of which leads to the side of each low pressure steam chest. The exhaust piping for the low pressure engine is in accordance with the builders' previous standards, having a ball joint at the Y connection that is secured to the front of the two steam chests and conveys the exhaust steam to the centre line of the locomotive. From this joint it is carried back to a ball joint at the bottom of the smoke box. This ball is held in place by a coil spring. Between the two is a slip joint packed by snap rings and water grooves. The design is so worked out that when the exhaust pipe is removed, the receiver pipe can be slid in place or removed from the front end of the locomotive without further dismantling.

Cylinders, Valves and Valve Gear.—The cylinders are all cast separate from their respective saddles. The high pressure saddle is composed of two pieces, the upper comparatively small part being riveted directly to the boiler. The main saddle is then bolted to this and the cylinder castings are bolted to the saddle and also to the frames. Each frame is extended forward under the saddle in the form of a single rail 12 in. in depth, and thirteen of the 49 bolts holding the cylinder in place pass through this frame. The parts are also keyed together at the front, and the extension of the frame ahead of the cylinders fits between rails of the front frames to prevent them from getting out of vertical alignment. At the low pressure cylinders, the saddle,



Sections of Powerful Mallet Locomotive on the Great Northern.

which acts as a support for the cylinders but carries no superimposed weight, forms part of the frames. This is in accordance with the previous practice of the builders. Each cylinder casting is held in place by twenty-two 1½ in. bolts and is lipped over the saddle so that the bolts are free from shear.

The steam distribution to all cylinders is controlled by inside admission 15 in. piston valves of the built-up type. The high pressure valves are of the usual design, but in the low pressure steam chests double ported valves have been installed.* The Walschaert valve gears are operated by a Raggonet power reverse gear. The lift shaft of the high pressure engine is straight and supported by brackets secured to the guide yoke. On the right hand side it carries the arm connecting to the power reverse gear, and on either side are arms supporting the hangers to the radius bars. In-as-much as the shaft is set very low, the connection of these hangers to the radius rods is formed in lugs cast on the bottom part of the bars, considerably increasing the length of the hangers. On the lift shaft at the centre is another arm extending downward in a vertical direction when the mechanism is at mid gear. This has a slotted opening in which a block is fitted. Secured to this block and fitted around it and the arm is a reach rod which also extends back of the block for a distance of about 10½ in. At the forward end it connects to a small crosshead in the centre of the high pressure saddle, from which another rod reaches forward to the reverse gear on the low pressure unit. Fitted around the lift shaft of the high pressure engine is a sleeve which has two arms, one extending up on the right hand side of the locomotive and connecting to a screw operating mechanism in the cab, the other one, 10½ in. in length, extending backward and connecting to the end of the extension of the front reach rod back of the block. Thus by means of the screw gear in the cab the length of the lever arm controlling the movement of the low pressure reverse mechanism can be changed and the relative point of cut-off of the two cylinders can be altered at will. This relation, however, will be maintained independent of the reversing or movement of the power reverse gear which will control both gears at all times. When the high pressure engine is in full gear the cut-off of the low pressure cylinders can be reduced with this device to a minimum of 20 per cent. An extra steam gage which gives the pressure in the receiver pipe has been located in the cab.

Extension piston rods have been omitted on both the high and low pressure cylinders of these locomotives. The pistons have dished bodies of cast steel with cast iron bearing rings which are 6 in. in width except at the bottom, where they are increased to 8 in. Each piston is also fitted with two packing rings which are sprung in place. The valve stem crossheads are supported on brackets forming part of the back head of the steam chest, a practice which can now almost be considered standard for new locomotives.

Frames.—The frames are annealed open hearth cast steel, and particular attention has been given to transverse bracing. On both the front and back frames cast steel braces are placed midway between adjacent driving axles and are bolted to both the upper and lower frame rails. The two rear braces on the front group are cast in one piece with the lower section of the waist bearer. Both of these bearers are under load and the forward one has a spring centering device.

The front truck is equalized with the leading pair of driving wheels, while the second, third and fourth pairs of the front group are independently equalized on each side of the locomotive. At the rear, equalization is continuous on either side without cross connection.

Restricted clearance limits made it difficult to place sand boxes on the top of the boiler and a supply of sand is carried in two boxes placed over the front deck plate. Sand is delivered in front of the leading driving wheels only. The bell is placed on the left hand side on the round of the boiler because of clearance restrictions.

The oil supply for the high pressure cylinders is conveyed direct to the steam chest, but that for the low pressure cylinders is discharged at the back end of the receiver pipe. The low pressure cylinder cocks are pneumatically operated by a small cylinder placed over the forward deck plate.

The tender frame is composed of 12 in. channels. The trucks are of the equalized pedestal type with cast iron chilled wheels weighing 925 lbs. each.

General dimensions, weights and ratios are given in the following table:

General Data.

Gage	4 ft. 8½ in.
Service	Freight
Fuel	17 coal, 8 oil
Tractive effort, compound	100,000 lbs.
Weight in working order, estimated	450,000 lbs.
Weight on drivers, estimated	420,000 lbs.
Weight on leading truck, estimated	30,000 lbs.
Weight of engine and tender in working order, estimated	600,000 lbs.
Wheel base, driving	43 ft. 3 in.
Wheel base, rigid	16 ft. 6 in.
Wheel base, total	52 ft. 6 in.
Wheel base, engine and tender	83 ft. 1 in.

Ratios.

Weight on drivers ÷ tractive effort	4.20
Total weight ÷ tractive effort	4.50
Tractive effort × diam. drivers ÷ equivalent heating surface*	740.00
Equivalent heating surface* ÷ grate area	108.20
Firebox heating surface ÷ equivalent heating surface*, per cent	3.84
Weight on drivers ÷ equivalent heating surface*	49.40
Total weight ÷ equivalent heating surface*	53.00
Volume equivalent simple cylinders, cu. ft.	33.60
Equivalent heating surface* ÷ vol. cylinders	253.00
Grate area ÷ vol. cylinders	2.34

Cylinders.

Diameter and stroke	28 in. & 42 in. x 32 in.
Kind of valves	Piston
Diameter of valves	15 in.

Wheels.

Driving, diameter over tires	63 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11 x 12 in.
Driving journals, others, diameter and length	10 x 12 in.
Engine truck wheels, diameter	33½ in.
Engine truck, journals	6 x 12 in.

Boiler.

Style	Belpaire
Working pressure	210 lbs.
Outside diameter of first ring	90 in.
Firebox, length and width	117¼ in. x 96¼ in.
Firebox plates, thickness	⅛ in. & ⅝ in.
Firebox, water space	F., 6 in.; S. & B., 5 in.
Tubes, number and outside diameter	332—2¼ in.
Flues, number and outside diameter	42—5½ in.
Tubes, material and thickness	Steel, No. 11 B. W. G.
Flues, material and thickness	Steel, No. 8 B. W. G.
Tubes, length	24 ft.
Heating surface, tubes	6,120 sq. ft.
Heating surface, firebox	326 sq. ft.
Heating surface, total	6,446 sq. ft.
Superheater heating surface	1,368 sq. ft.
Grate area	78.4 sq. ft.

Tender.

Frame	12 in. channels
Wheels, diameter	36 in.
Journals, diameter and length	5½ x 10 in.
Water capacity	8,000 gals.
Coal capacity	13 tons

* Equivalent heating surface equals 6,446 + (1.5 × 1,368) = 8,498 sq. ft.

*See *American Engineer*, March, 1912, page 141.

Electric Traction in Great Britain.—Electric operation on railroads in Great Britain covered lines having a total length of 258 miles of single track at the end of 1911, according to the most recent official reports. Of this amount 206¾ miles are operated solely by electricity. In 1910 the mileage using electricity was 229¾. The increase has been largely on the London, Brighton & South Coast.

Average Net Return on the Value of Property.—Approximately the percentage of net return on the capital value of manufactures in 1900 was 17.119 per cent. and that on the cost of road and equipment of railways was 4.650 per cent. In 1910 when the capital value of manufactures had increased 105.3 per cent., the percentage of net return was 12.041 per cent., while on the cost of road and equipment of railways, which had increased 40.2 per cent., the percentage of net return was 5.729 per cent.

RAILWAY ELECTRICAL ENGINEERS' ASSOCIATION

Program Included Reports on Shop Practice, Shop and Postal Car Lighting, Steam Turbines, Etc.

The fifth annual convention of the Association of Railway Electrical Engineers was held in the Auditorium Hotel, Chicago, October 20-25. F. R. Frost, electrical engineer of the Atchison, Topeka & Santa Fe at Topeka, presided. The secretary-treasurer reported a cash balance of $1,044 and a total membership of about 550.

AXLE LIGHT EQUIPMENT.

A report on Data and Information was submitted by a committee of which E. W. Jansen (Ill. Cent.) was chairman. Following is an abstract of that part referring to axle light equipment:

One of the most important points to be considered in placing axle light equipment on the car is a good suspension and the method in which the suspension is attached to the truck. On cars with steel trucks the suspension should be secured to the truck without any chance of vibration. It is advisable, where possible, that large axle and dynamo pulleys be used. This will increase the life of the belt. A statement of belt mileage made on different classes of cars using the highest grade of 5-in. 4-ply rubber belt with 11-in. dynamo pulleys and 21-in. axle pulleys, is given as follows:

	Jan.	Feb.	March.	April.	May.	June.
Cars	117	118	121	117	109	117
Belts	48	26	34	19	28	19
Average mileage per belt.	25,952	44,032	37,192	59,702	45,155	79,878

The reason for the low mileage in winter months is because of the ice and extremely cold weather.

From a report of the light failures, that is, those cars which arrived at a terminal with less than 25 volts, or 35 volts where tungsten lamps were used, it was shown that out of 120 cars, 14 failures were shown in January, or 88,900 miles per failure; six failures, or 199,000 miles per failure, in February; 13 failures, or 101,000 miles per failure, in March; 11 failures, or 107,000 miles per failure, in April; seven failures or 187,000 miles per failure, in May, and two failures, or 661,000 miles per failure, in June. From the statistics of 58 different roads it was shown that 13,736 cars were lighted by electricity and 29,075 were lighted by other means, or about 32 per cent. are lighted by electricity. Of these 1,673 have straight storage; 481 are lighted with turbines; 2,073 have the head end system and 7,100 have the axle generating system.

SHOP PRACTICE.

The committee on shop practice, C. J. Causland (Penn.), chairman, presented a report of what is considered good practice by shop engineers of the leading railways. An abstract of the report follows:

Power Plant.—Steam turbines are being used to a very large extent in railway power plants, due to their smaller size and greater economy than reciprocating engines, but there is still much to be said in favor of the latter. They are favored by many engineers for driving direct current generators, with the turbine as the favorite for alternating current machines. One point which has always been mentioned in favor of the reciprocating engine is the use of its exhaust steam for heating the shops, but this applies only to non-condensing engines, usually. Recent developments in steam turbines have brought about a type designed especially with a view to using it in connection with steam heating systems. The large amount of glass used in railroad shops, with the consequent great radiation of heat, makes the heating problem an important one, but beyond the province of this report.

The switchboard should not merely contain panels enough for all of the generators and feeders, but each panel should have a complete equipment of meters, switches, etc., in order to allow of the fullest knowledge and control of conditions in each circuit.

If the power is to be transmitted over any very great distance, which seldom happens in railway shops, the voltage should be as high as possible for safety, in order to reduce the amount of copper required for the lines and to keep the terminal voltage up to as nearly normal as possible. Either a. c. or d. c. distribution can be made safely at 440 volts and this is high enough for any railway shop at present constructed, and if the power plant is properly located it will do for any plant that will probably ever be constructed.

The electric distribution system should be kept away from the heat of the steam pipes and the practice of putting the cables in ducts placed alongside a pipe tunnel, instead of having them in it, is better practice. This plan is followed in the Big Four shops at Beech Grove, Ind.

Where alternating current is used it is customary to locate transformers at the various distribution centers for stepping down the voltage to that required for the lights or motors. Usually these are located on poles outside the buildings, sometimes inside, but when the distribution system is underground the transformers must be inside the buildings or in manholes. At the Pullman shops manholes are placed at each of the principal distribution centers, outside the buildings, with the step down transformers therein for reducing the voltage from 2,300 volts to 110, 220 or 440 volts as required.

Shop Equipment.—Each shop presents conditions of its own. One of the most important things is a good set of accurate records of time, operations, materials, machines, men and methods. Another is as to whether group drive or individual drive is going to be best for any one department or the entire shop.

There is practically no argument as to the use of anything but electric motors where they are at all applicable, and that means practically any place where power is used to produce motion. Among the benefits gained through their use are decreased transmission shaft losses, increased production through easy speed control, accurate knowledge of power required for any given purpose, ease of power control and distribution, flexibility of machine arrangement, reduced vibration of buildings and machines and the elimination of most belt troubles.

The present tendency in locomotive shop equipment is to increase the number of machine tools per pit. The average is between 6 and 8 per pit, with many shops having from 5 to 6, but the tendency is towards from 8 to 10 per pit in several of the newer shops. There is no fixed rule, apparently, as to how many tools of each kind will be required per pit, but an average of a large number of shops shows the following proportions:

Turning tools	50 per cent.
Cutting tools	25 per cent.
Drilling tools	11 per cent.
Grinding tools	7 per cent.
Miscellaneous	7 per cent.

Nearly all wood-working machines in electrically operated shops are fitted with individual motors because of the comparatively large amount of power required. Induction motors with squirrel cage windings are used for this purpose on account of the freedom from sparking and the constant speeds.

The use of the automatic controlling devices is increasing. Suitable devices for both variable and constant speed motors are now available, most of them being arranged for push button control. The use of push buttons reduces the chances of injury to both workmen and tools, and makes it so easy to start and

stop the machines that the men will stop them during idle periods instead of allowing them to run and waste power. The automatic starters also have certain protective features which are valuable, most of them opening the circuit on overload.

Another useful practice is being followed in regard to compressed air supply. This is the placing of small motor-driven air compressors in all shops requiring air outside of regular working hours. In this way a small amount of compressed air may be provided without operating the large air compressors in the main power houses.

The use of electrically operated safety devices of a variety of kinds could be extended to good advantage, and a new system for this purpose will soon be placed on the market. This is designed to stop the machinery instantly in case of accident and may be operated from any part of the shop. Automatic fire alarm systems are also being neglected and the risk greatly increased as a result, with no good excuse. This is also worth consideration and improvement.

STEAM TURBINES.

A paper on the Commercial Efficiency and Application of Small Steam Turbines was presented at the Wednesday afternoon session by W. J. A. London and Ashley P. Peck. A brief abstract follows:

As a general rule, the small turbines are applied to the auxiliaries of a plant, such as exciters, boiler feed, circulating and hot well pumps, where the exhaust steam may be used in the feed water heaters or for other purposes; in such instances the efficiency of the turbine may be sacrificed to gain additional reliability, for the ultimate thermal efficiency will be high. Less work is required in the care of these units than in the ordinary reciprocating engines, and they stand considerable hard usage, instances being known where turbine pumps have run while completely submerged in water. As prime movers for generators for power and light the turbine has the advantage of occupying small floor space, requiring little attention and no adjustments during long periods, and maintaining its original efficiency. They may be successfully applied to direct current generators, using 500 volts or less.

In the discussion of this report the question of exhaust or low pressure turbines was considered, and it was pointed out that where there were sudden demands for current presenting several peak loads throughout the day the exhaust turbine was not a valuable adjunct. However, in the case of an evenly loaded plant, such as a manufacturing plant or a railroad shop, an exhaust turbine will prove economical.

INDUSTRIAL LIGHTING.

In a paper on Industrial Lighting by B. F. Fisher, Jr., several important points concerning shop illumination were considered. In the first place, the problem should be very carefully studied as to the location, reflection and power of the lamps. They should be so located as to provide the light where desired and as efficiently as possible. In many old installations a large part of the light is absolutely wasted by being allowed to diffuse too generally over areas where it is not needed.

The arc light and high power incandescent lamp were recommended for general use in rooms with high ceilings, the arc or mercury vapor lamp for medium high ceilings and the mercury vapor and incandescent lamps for low ceilings. In the case of the medium ceiling, the mercury vapor lamp was recommended in preference to the arc when it was desired to eliminate sharp shadows. The proper diffusion of light may be obtained by using the necessary deflectors and by their use the power required for lighting may be greatly reduced. The power of the lamps should be as high as possible to give the desired illumination. Of course, different problems will require different arrangements and numbers of lamps. Cases where shadows are very undesirable will require a larger number of lights than where the shadows are not considered and they will be of less power, but where it is desired to increase the illumination it should be done by higher power lamps rather than by increasing the number of low power lamps.

The comfort of the employees should be considered. It will be found that artificial illumination at dawn, twilight or gloomy weather will require considerably more candle power than after dark, and shops operating under those conditions should be equipped to give that extra amount of light. Much may be gained by the proper arrangement of the circuits; for instance, where a shop works through from daylight to darkness, as many do in the winter months, the circuits should be arranged parallel to the windows so that at the beginning of darkness the circuit in the center of the shop may be turned on first and so on out to the windows.

Care should also be taken in the original lay-out of a shop to provide for any change in the location of the machinery; in other words, the units should be so located that a machine may be operated with equal efficiency, as regards light, from any angle.

Another important point brought out was that of keeping the lights and reflectors clean and free from dust and dirt, for it is very easy to lose 50 per cent. of the original illumination in this way. A man should be commissioned to keep both the reflectors and the lamps clean, washing them with soap and water, if the full benefit of the lighting system is to be realized. The lamps should be located where they will not become spattered with oil or grease or other dirt.

POSTAL CAR LIGHTING.

A. J. Sweet presented a paper on Postal Car Lighting, in which he mentioned shadows, light in the eyes of the mail clerks, specular reflection, and the intensity of light, as being four important points to be considered. The shadows may be somewhat eliminated by the correct location of the light units. The lights should be high enough so they will not shine in the eyes of the men. The specular reflection may be greatly reduced and almost elminiated by sufficient diffusion of the light and this is best obtained by the indirect lighting system, which, however, has not been found practical in postal car service. The intensity of the light should be at least 2¼ foot-candles at the reading height above the floor and 3½ foot-candles would be considered very satisfactory. The efficiency of the illumination of the car will be largely influenced by the type of reflector used on the lamps and the way in which the light is directed to where it is needed. It was shown that with various types of reflectors a light efficiency from 25 to 62 per cent. could be obtained, the 25 per cent. being obtained in the indirect lighting system and the 62 per cent. with the use of a mirror reflector. The illuminized metal reflector was rated at 44 per cent. efficiency and was recommended for use in this service, as it was the only reflector that gave a high efficiency that could be considered practical, as the mirror, the prismatic and the opal reflectors were likely to be broken in cleaning due to rough handling.

Mr. Sweet recommended the 50-watt lamp as giving the best service and being more economical as to wiring, fixtures, etc. He also pointed out that the cost of perfect maintenance will more than pay for itself in the increased lighting efficiency. In other words, it would be much cheaper for the railroads to reduce their factor of safety in the intensity of light and keep the lights well maintained. A system should be inaugurated so that the reflectors to be cleaned may be replaced by reflectors already cleaned; they should be taken from the car and given a thorough washing.

C. M. Reed, chairman of the postal car committee for the Railway Mail Service, mentioned specifications on lighting that are to be presented in the near future. He intimated that a lighting efficiency of 99⅓ per cent. would be required of all postal cars and that this would be determined from the trip

failures. If a road will guarantee this efficiency, candles will be allowed for auxiliary lighting. If, however, a road does not agree to this efficiency, or if it is found that this efficiency cannot be maintained, an auxiliary lighting system will be required of either oil or gas. Mr. Reed also recommended the single row of lights along the ceiling. On request of several of the members present he agreed to consider instructing the mail clerks to report any defects or items, whereby the efficiency of the equipment may be increased, directly to the inspector by means of a note directed to him and placed in a box in the switchboard locker. The system on the Lehigh Valley was spoken of, whereby the postal clerks leave notices to the inspectors in the switchboard locker and also notify conductors when anything serious is the trouble with the lighting system; in this way it is possible for the conductor to wire ahead for an electrical inspector to board the train and correct the difficulty if possible. It was clearly shown that the postal car committee on the part of the government was ready in any way to help the railroads in maintaining the efficiency of their postal car equipment.

OTHER PAPERS.

Committee reports were also presented on the Train Lighting Practice, Installation of Wiring, Improvements. Standards and Specifications.

The report of the committee on train lighting practice, F. E. Hutchinson (C. R. I. & P.), chairman, included the various methods of operating electric lighted cars, the cleaning of batteries, and reports on electric lighted cars. It was stated that the sediment removed from the batteries should not be thrown away as it could be sold for $40 a ton. A form of inspector's report was also recommended.

The committee on wiring considered engine houses, machine shops, engine rooms, boiler rooms, storehouses, oil houses, coal sheds, cinder pits, passenger and freight stations. In most every case the wiring was recommended to be run in conduit and that the fittings should be of the standard grades of sherardized or galvanized material. The insulation of the wire should be of high quality rubber, paper or varnish cambric, and all the wiring should follow as closely as possible the National Board of Underwriters' code. It was especially brought out that considerable money could be saved by studying carefully the general problem of wiring.

Under the subject of improvements a report of the several companies manufacturing axle lighting equipment, axle pulleys, belt fasteners, electric meters, ball bearings, generator connectors, lighting systems, storage batteries, car lamps and fixtures, fans, motors, electrical instruments, headlights, ventilating equipment, wire and wiring devices, etc., was presented showing the improvements made in their special lines.

The committee on standards presented its recommendations in contrast to those recommended by the M. C. B. committee on train lighting. In most every case these standards were identical, the exceptions being in the notices required on the switchboard locker, which in the case of the Electrical Engineers, are more complete, and in the M. C. B. recommendation No. 12 was objected to. Also there was a difference of five cents in the labor cost for electrical service; the M. C. B. Association recommended 30 cents, while the Electrical Engineers recommended 35 cents. A consensus of opinion is to be obtained from the members of the association concerning other recommendations which will be forwarded to the M. C. B. committee on train lighting.

Complete specifications were presented on rubber belting for axle generators, rubber covered wire and cables, and incandescent lamps which were referred to letter ballot.

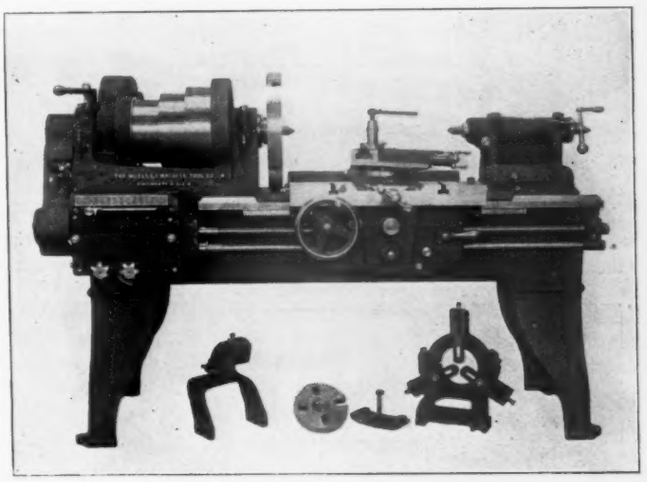
A paper was also presented by N. W. Storer, general engineer, Westinghouse Electric & Manufacturing Company, on Electric Traction, an abstract of which is presented elsewhere in this issue.

OTHER BUSINESS.

The following officers were elected for the ensuing year: D. J. Cartwright, electrical engineer, Lehigh Valley, president; C. R. Gilman, chief electrician, Chicago, Milwaukee & St. Paul, first vice-president; H. C. Meloy, chief electrician, Lake Shore & Michigan Southern, second vice-president; Joseph A. Andreucetti, general foreman, Chicago & North Western, secretary and treasurer. The following executive committee was also elected: L. S. Billau, assistant electrical engineer, Baltimore & Ohio; E. W. Jansen, electrical engineer, Illinois Central; F. E. Hutchinson, chief electrician, Chicago, Rock Island & Pacific; C. J. Causland, chief electrician, Pennsylvania Railroad; Willard Doud, shop engineer, Illinois Central, and W. A. Del Mar, electrician, New York Central & Hudson River. The next annual meeting will be held in Chicago, and the semi-annual meeting in Atlantic City.

HEAVY DUTY 18-INCH LATHE

A powerful engine lathe which, while having no particularly new features of a general nature, is an excellent example of the modern tool for heavy duty is shown in the accompanying illustration. This machine has been designed and is built by the Mueller Machine Tool Company, Cincinnati, Ohio. It is strong and rigid in every particular, and the most modern types of speed and feed changing devices have been provided. The standard machine is provided with a three-cone belt drive and has double back gears of the slip gear type, the changes being made through the medium of a lever conveniently placed at the front of the machine. The back gear ratios are 3½ and 10½ to 1. There are nine spindle speeds ranging in geometrical progression from 13 to 300 and the screw cutting arrangement



New Mueller 18-in. Lathe.

provides for 45 changes of thread, ranging from two to sixty, including the 11½ in. pipe thread. These are all obtained within the quick change gear box and a chasing dial on the carriage permits the catching of threads at any point without stopping the machine. The feeds are all positively geared and can be started, stopped or reversed in the apron or head, for either a cross or lateral feed motion, only when the lead screw nut is disengaged.

To prevent the bottom slide on the carriage from overhanging its bearings when large diameter pieces are being turned, both the tailstock and headstock are set off center. The machine will swing 18½ in. over ways and 13¼ in. over the carriage.

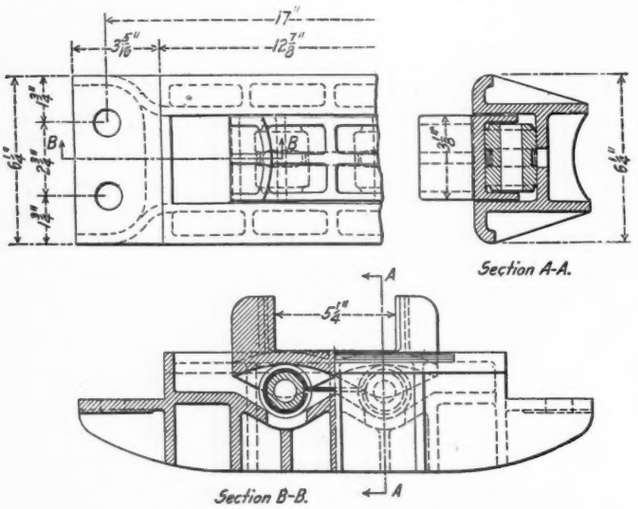
All materials used are those which have been decided to be the best for the different purposes after long experience in lathe building. All gears in the gear box, and many others throughout the machine, are of steel cut on special cutters and

all are completely covered. The spindle is of carbon crucible steel and runs in phosphor bronze bearings. The cast iron parts, including the bed, have the metal distributed in the most effective manner to resist the strains imposed.

This lathe will turn a length of 2 ft. 4½ in. between centers; has a 6 ft. 3¼ in. bed and weighs 3,200 lbs. A motor drive or a longer bed can be obtained if desired.

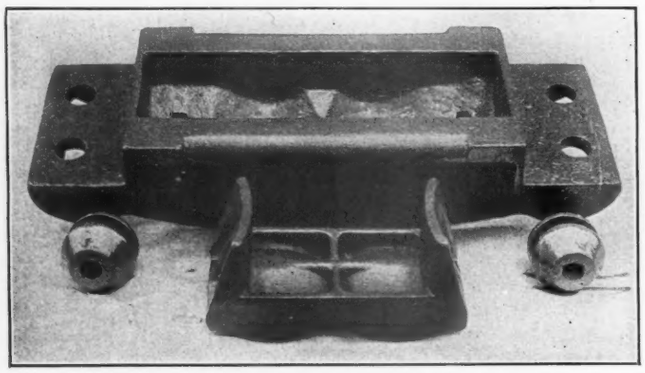
GRAVITY COUPLER CENTERING DEVICE

A device for centering couplers which does not require the aid of springs is shown in the accompanying illustrations. It includes a cast steel carry iron of much the same form that is now generally used in steel freight cars, the essential difference being that there are two concave recesses cored in the center.



Powers' Gravity Centering Device for Couplers.

Two cast steel rollers connected by a bar, rest in these recesses and on them rests the carriage that carries the shank of the coupler. It is evident that when the coupler is off center on either side it will be lifted up and its weight will tend to force the rollers to the bottom of their cavities and thus return the



Details of Gravity Centering Device for Couplers.

shank to the central position. This device adds bust about eighteen pounds to the weight of the car. It is evidently durable and not subject to either wear or disarrangement. It has been patented by Robert E. Powers and is furnished by the Powers Gravity Company, Montreal, P. Q.

New Jersey Railroad Valuation.—The valuation of railroad property in New Jersey has been increased $38,000,000, making a total of $324,541,117. The taxes will amount to $6,183,530.

STEEL PASSENGER CAR PAINTING*

BY J. W. LAWRIE,
Manager, German-American Chemical Works, Milwaukee, Wis.

Paints for steel have different functions, in many respects, than those for wood. In painting steel we have the absorption into the pores to only an extremely limited extent, compared to that which we have in painting wood. For this reason there must be some other way adopted for getting the strong clinging effect that the pores of wood afford as an anchorage for the paint coats. It is almost necessary to assist an oil paint with something which is a better adherer to steel than linseed oil. For this reason a certain amount of varnish is found in all steel primers. At the same time the pigments which have answered for wood may or may not do for steel. It has been established in a practical way, as well as experimentally, that the fewer the number of paint coats on steel, which will give the maximum protection, the longer wearing and better service will the paint coating give.

The pigment must give the color and shade desired, opacity and thickness of film; it affects the life of the paint, both by its actinic action due to its color absorption, etc., and its chemical effect on the oils or vehicle. It should be such as to give the maximum inhibition of corrosion on the steel. Corrosion itself may be due to several factors. Moisture must be present for continuous corrosion; acid, gases and oxygen assist, and any free acid, such as is used in pickling steel, is a strong inducer of corrosion. When these causes are considered an attempt to get ways of overcoming their effects and so approach perfect inhibition of corrosion can be made. It must be borne in mind, however, that inhibition of corrosion is only one of the desirable qualities of a paint for steel.

There are essentially two or perhaps three great classes of pigments as regards their effect on steel. These classes can be called the electrical, the chemical and the passifiers. Examples of the passifiers are the chromates, which seem to render the steel immune to oxidation.

In line with the electrolytic theory of the corrosion of steel, the differences in electrical potential produce a current of electricity in the direction of the high to low, or positive to negative. The different pigments show considerable difference in their relation to steel, and for this reason if pigments are used which are positive to steel, then in any flow of current the positive material would go into solution and the negative material, or, in this instance, the steel, would be protected. Such pigments would therefore be inhibitors of corrosion of steel. Those of the same potential, or neither positive nor negative to steel, would be neutrals, and those negative would be accelerators.

The chemical pigments are those which through their particular chemical properties, such as acidity, either direct or through hydrolysis, neutrality, or alkalinity, affect the steel so as to inhibit or accelerate corrosion. It is practically established that there is a minimum alkalinity below which there is no inhibition, and also with too strong alkalinity the action of the pigment on the vehicle oils is so pronounced that such pigments are detrimental to the life of the paint. Practically all pigments belong to both the electrical and chemical classes. A pigment may be positive to steel, and yet in itself, or by hydrolysis, be so acid in action that instead of being, as would be expected, an inhibitor, it is, instead, a strong accelerator of corrosion. In the same manner, a negative pigment may be sufficiently alkaline as to become an inhibitor. Many pigments are both positive and alkaline, and therefore extremely good inhibitors. Others are neutral, either through opposing electrical and chemical properties (as applied to inhibition, etc.), or are neutral of themselves in all respects. Again, other pig-

* Abstract of a paper presented at the Eighth International Congress of Applied Chemistry, held in New York, September, 1912.

ments are negative and acid, and so strong accelerators. There are, of course, all grades and stages in these valuations. It is, however, possible by test to identify the different properties of the different pigments and combinations of pigments, and so classify them as to their actual value for inhibiting corrosion.

It is possible to measure directly differences in potential between pigments and steel, and also the relative acidity or alkalinity, either as a direct property or as one produced by hydrolysis. These tests can be applied directly to most pigments, but not to all. There is one test which may be considered final and fair. That is, an actual exposure test of the pigments combined into paints and applied to steel panels under different exposure and weather conditions. It must be admitted at once that such tests are not absolute, but their relative value cannot be disputed. It is impossible from the results of such tests as those at Atlantic City to say that the American vermilion is 10 times as good a pigment as some other pigment which would be rated at 1. The relative fact is that American vermilion is a first-class inhibitor of corrosion, whereas the paint rated at 1 is not an inhibitor and is probably one of the negative pigment paints, and therefore an accelerator.

The writer has been experimenting for a long time with the so-called razor blade test for both pigment and vehicle. The test is made by completely separating the pigment from the vehicle by solvents and the centerfuge, so that there is no trace of the vehicle left with the pigment. The pigment is then re-ground until all of it passes through a 100-mesh sieve. It is then made into a stiff paste, with water, spread out on a square of filter paper and the emeried razor blade is wrapped up in the pigment in such a manner that the pigment is in intimate contact with the surface of the blade all over. The wrapping up of the blade properly has much to do with the success of the experiment. The blades are left for about 21 days, being kept moist all the time. They are then cleaned, re-weighed, and the loss in weight, together with the appearance of the blade, gives the value of the pigment for steel protection. The results so obtained have been followed with outdoor exposure panels, and the conclusions arrived at from the razor blade test check with wonderful accuracy the results obtained by exposure. As examples of these checks the relative values placed on some of the Atlantic City steel panels and the losses on the razor blades are given as follows:

	Loss Razor Blade.	Atlantic City rating.
American Vermilion	.0005	10
Sublimed White Lead	.0015	9
Corroded White Lead	.0247	2½
Red Lead	.0003	9
Zinc Chromate	.0004	9

Tests on over 200 different pigments and mixtures of pigments have been made with the exposure test for a check. The results indicate that when properly carried out the blade test is reliable and of great value where time is such an important factor as in large testing laboratories.

In like manner the vehicle can be tested for its value as a resister of moisture and gases. The emeried and weighed razor blade is dipped into the separated vehicle and given two coats, with proper drying intervals. The blade is then subjected to alternating treatments with water and moist sulphur dioxide, and carbon dioxide gases. This treatment is continued for a period of 11 days. The blades are then cleaned and re-weighed. The appearance and loss in weight give the relative value of the vehicle as a resister of moisture and gases. Here the filmometer may be used with great success. This particularly where tests are made on paints from competing companies, and designed for the same purpose. The test of the resistance of the film to acid and gas penetration is of extreme importance. We have in railway service to contend with sulphur dioxide and carbon dioxide gases, as well as an almost continuous presence of moisture. For this reason the paint must be able to exclude these gases and moisture. This exclusion depends largely on the nature of the vehicle. Straight linseed oil or soya bean or other like oils, will not exclude completely. If, however, a gum varnish is added to the oil the porosity is largely stopped. This, of course, is more or less perfect, according to the amount of varnish used, its kind, etc. At the same time the physical condition of the pigment must be considered, as too coarse a pigment will practically always leave a porous film. Too much varnish on the other hand, especially in a priming coat, will leave a glossy surface, to which the second coat will not adhere well. At the same time it is well established that varnish will not carry a large amount of pigment and give successful outdoor surface. It is for this reason that there have been so many failures with the so-called "quick process methods" of finishing steel cars.

Many tests have been made to establish the value of baking the paints on steel cars. Our results and practical experience, based on these tests, have shown that the life of the baked paint on steel is prolonged wonderfully and also the adherence to the steel itself is very much better. At the same time the baking has the additional value of making the vehicle much more impervious to moisture and gases than the same vehicle unbaked. Numerous experiments with certain kinds of vehicles baked gave a resistance in this way of almost three times that of the same vehicle unbaked. The mechanical difficulties of baking an entire car are large. In this respect, the removable sheathing of the modern Pullman is of a decided advantage, as it can be readily taken off, the paint removed, the sheathing re-painted, baked and placed back again on the car as before. There are some other difficult problems involved in the baking of the paint. It is the best practice at the present time to bake the surfacer. This baking produces an extremely hard and brittle coat. Up to the present, when it is necessary to refinish such a car, no chemicals have been found which will successfully remove this baked surface. It is, however, possible to remove all coating over the surfacer and then rebuild up again in the regular manner. Here again the problem of baking the entire car is paramount and so far the problem has not been solved with entire success.

The baking temperature and length of time baked have a great deal to do with the life service of the paint. In general, the lower the temperature and the longer the time the paint is baked, the better the wear, service and resistance to moisture, and the more elastic the film. Twelve hours at 180 deg. F. are better than five hours at 280 deg. F.

There is no longer any argument with regard to the preparation of the steel for painting. Wherever possible sandblast. Pickle only when no other means are available to remove scale and rust. Pickling with sulphuric acid gives under the usual factory methods the best accelerator of corrosion of any agent met with in regular railway service. Capillary attraction is an extremely powerful force. The sulphuric acid by this force enters the spaces between the crystals of the steel and is held very tenaciously. A mere dipping in a bath of water or several baths of water fails to remove all the acid and with the hydroscopic nature of sulphuric acid an ever-increasing area of steel is subjected to acid action. The whole sheet begins to corrode under the paint coat. Even with a paint which is inhibitive and moist-proof such action will soon destroy these valuable properties. The action of the acid is cyclic and almost unending. Ferrous sulphate is readily converted to ferric sulphate and with moisture to ferric hydrate. Under these conditions the ferric hydrate is precipitated out of solution and does not re-act further with the acid. The acid is re-generated and again re-acts with the steel, etc. The ferric oxide formed is electro-negative to steel and with moisture and acid a current is established, carrying iron ions from the steel into solution. These are precipitated out as more ferric hydrate or oxide and so again the action proceeds ad infinitum. It would be better to pickle with hydrochloric acid than with sulphuric acid even at a higher cost, because this acid is not hydroscopic; it is volatile at a low temperature and its capillary force is small

compared to that of sulphuric acid. If it is necessary to pickle with sulphuric acid, then wash with a stream of hot running water, so as to overcome by heat, force and dilution the capillary strength of the acid. Treat with lime water and wash again, dry and oil.

There is one feature of steel car building that is generally neglected. The outside surface of the steel is taken care of in a more or less respectful manner, but the inside of the sheet is usually given a coat of slush paint and the scale is seldom removed. Oil may be on the surface, or rust already formed. This treatment is certainly to be condemned. The inside of the outside and the outside of the inside sheets form a box with little ventilation, but usually holding a great deal of moisture. The paints used are seldom good resisters of moisture, and as a result corrosion starts and is aided by the conditions until there is often danger that the inside of the sheet will corrode through before the paint on the outside has seen decent service. As color is of no interest in this case it is easily possible to apply a good inhibiting and moisture resisting paint on these unseen sides of the sheets of steel and so prolong the life of the car very much. It is also a matter of general safety to properly paint this material, as it is impossible to get at the surface for repainting after the car is in service.

Where molding abuts on steel sheets it is usual to interpose sheet copper between the two pieces of steel. This is to produce as near a water tight joint as possible. The fact remains that the joint is never entirely water tight. Copper is electro-negative to steel and the steel therefore goes into solution and rapid destruction takes place. Aluminum, on the other hand, is electro-positive to the steel and so it goes into solution and saves the steel. It soon coats over with oxide and thus the reaction is largely diminished. The steel itself is entirely protected.

There are several essential properties which should be possessed by the different kinds of paint used on steel. The usual procedure is first, sandblast, next prime, and follow usually with a second but different primer; then filler and surfacer, color and varnishes. The essentials of a good first primer or first coat of paint on steel are that it adhere well to the steel, present a good surface for the second coat, and that it have a pigment that is a good inhibitor of corrosion. It is not essential that the vehicle be altogether gas and moisture proof, although it is better so. The second coat should adhere well to the first one. It should be primarily a paint that is a good excluder of gases and moisture. It does not have to have a strongly inhibiting pigment, but it is better with such a pigment. It is usual after the application of the fillers and surfacers to rub down to a smooth finish with water and pumice. This treatment requires undercoats, which will resist the water, and next to the steel a pigment that will prevent corrosion, even if some moisture gets through the outer coats. It has been possible to get better results from two coats instead of a single primer combining all qualifications. It is more practical also to get the resistance to moisture by making both coats moisture proof than by depending on the second coat alone.

The fillers or surfacers are designed to give a film such that it can be rubbed down to a smooth surface without tare and still be flexible. Most of them are fairly brittle and all of them are hard. The brittleness is increased with the baking. It is, however, possible to make a surfacer which will be hard enough to rub well and still be very elastic. Such an elastic surfacer will give to the paint coats as a whole much better wear and freedom from checking than a more brittle and non-elastic surfacer. The coats of color, etc., following the fillers are never or seldom baked. It is very difficult to hold the shades and finish constant when we bake the finishing color coats and varnishes.

High Flying.—Georges Legagneux, flying in a Marane monoplane September 17, rose to a height of 18,372 ft.

DENSITY OF LOCOMOTIVE SMOKE IN CHICAGO.

The average locomotive in the city of Chicago at the present time is making smoke the density of which is 14.92 per cent., according to records compiled by the engineers of the Chicago Association of Commerce Committee on Smoke Abatement and Electrification. This shows a decided improvement over the conditions recorded by the city smoke commission three years ago, when the average density was reported as 23.3 per cent. The percentage gives the ratio of actual performance to worst possible performance; that is, if a locomotive emitted dense black smoke all the time this record would be reported at 100 per cent. If it gave out no smoke at all the percentage would be zero. The figures give the results of innumerable observations covering the entire city, designated as Zone A, and also a zone beyond the city limits, designated as Zone B.

The committee's records covering all observations of locomotives are as follows:

In terminal yards and round houses.

Zone A (52 locations)	11.77 per cent.
Zone B (14 locations)	18.97 per cent.
Zones A and B combined	12.56 per cent.

In general service.

Zone A (comprising 141 divisions)	19.31 per cent.
Zone B (comprising 91 divisions)	26.02 per cent.
Zones A and B combined	21.12 per cent.

In yard service.

Zone A (71 yards)	16.7 per cent.
Zone B (27 yards)	23.4 per cent.
Zones A and B combined	18.2 per cent.

The total average in Zone A is 14.92 per cent. The average for Zone B is 19.12 per cent.

The grand total for Zones A and B is 16.42 per cent, which is the average density of locomotive smoke in the entire field covered by the investigations.

While figures are not available for an exact comparison, the recent reports of city smoke inspectors give even lower averages of smoke production, but the higher figures of the committee's engineers are held to be the result of a more exhaustive investigation, substantiated by voluminous records giving one minute interval observations for every half mile of track in the territory under surveillance.

The method of the committee has been to station its observers at an average distance of one-half mile apart along the line under observation at a particular time. Every effort is made to keep the knowledge of the presence of the observers from the enginemen, lest such knowledge have the effect of causing temporarily improved performance. The observers make records every minute of each locomotive in sight, and in this way a train going the entire length of the line is in turn observed by each observer stationed along the line.

The average density of smoke from stationary stacks in the city limits was reported as 10.27 per cent.; outside the city limits 25.97 per cent.; total average 13.08 per cent.

Steam vessels in Zone A are reported at 14.64 per cent.; in Zone B, 26.82 per cent.; the total average being 15.47 per cent.

Power Required to Drive Engine Lathes.—The following formula for the power required by engine lathes was reported by a committee of the Association of Railway Electrical Engineers at its recent annual meeting: Horse power = feed in inches × depth of cut in inches × inches cut per minute × number cutting tools × constant for material.

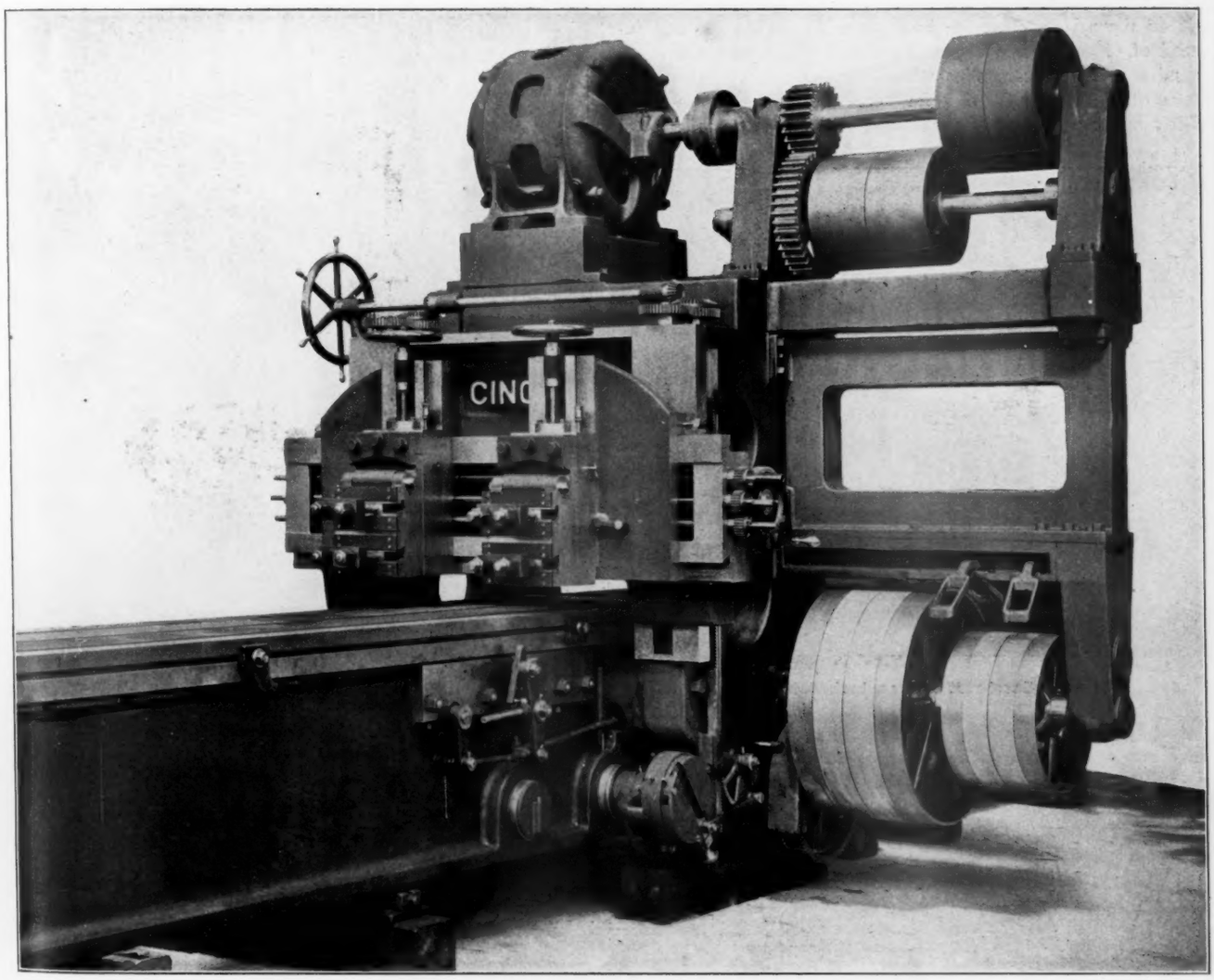
The constants for the various metals are as follows:

Brass	0.1
Cast iron (soft)	0.3
Wrought iron and cast iron (hard)	0.35
Mild steel	0.4
Medium steel	0.5
Tire steel	0.6

HEAVY FROG AND SWITCH PLANER

A new design of 36-in. frog and switch planer has recently been placed on the market by the Cincinnati Planer Company, Cincinnati, Ohio. The chief difference between this planer and the previous designs is that it is driven by a 50 h. p. motor mounted on top of the housings, and driving a countershaft with four 34-in. aluminum alloy pulleys. A massive frame supports the upper and lower shaft bearings holding them rigidly, so that there will be no spring while the heaviest cut is being taken. Four inch belts are used. The V-ways have a force feed lubrication which keeps a film of oil between the bed and the table at all times.

In other respects, the machine is similar to this company's previous 36-in. planer having a 32-in. table, housings with a 10-in. face, a 20-in. cross-rail, automatic cross and vertical feed heads and solid crucible steel rack and gearing. The table has an inside bearing on the bed, for its entire length, for resisting the side pressure of heavy cuts. Adjustable steel gibs are provided on each side to prevent lifting. The housings are secured to the bed by large bolts and dowel pins and a tongue groove 1½ in. deep by 5 in. wide. The cross-rail is secured to the housings by an extra set of clamps on the inside, in addition to the usual outside set of clamps. If desired, the cross-rail may also be fastened to the housings at various heights by large dowel pins. The belt shifting mechanism is provided with a safety locking device and the levers are so arranged that the machine may be operated from either side. The driving shafts are large in diameter, and are made from special crucible steel. The driving pulleys are so constructed as to require oiling only once in sixty days. The bull wheel and rack are unusually large, having a 12-in. face and 1½-in. pitch.



New Design of Cincinnati 36-Inch Frog and Switch Planer.

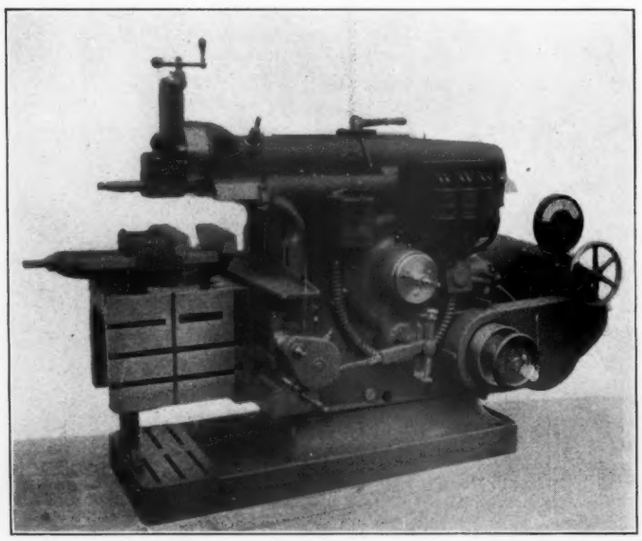
TWENTY-FOUR INCH SHAPER

In response to the demand of steel mills, railroad shops and drop forging shops for a shaper which will develop the full capacity of high speed steel tools on the heaviest class of work, Gould & Eberhardt, Newark, New Jersey, have designed a new 24 in. shaper which is designated as the Invincible type. A new patent construction permitting the position of the main bull gear to be raised considerably has been included in the design. This in itself has greatly increased the machine's mechanical efficiency, but in addition, there are a number of other new features, among which may be mentioned the increasing of the diameter of the bull gear hub from 3¾ in. to 6 in.; the increase in the size of the V bearings and gib which are arranged so that there is a solid metal to metal contact on each side of the ram bearing, and a reduction in the overhang of the crank pin. The crank pin thrust is taken by solid walls in the bull gear, no straps or bolts being used. There is a new front table support of much

heavier construction and the machine throughout has been made considerably more massive than the standard machine.

In raising the center of the bull gear, which is now 4¼ in. higher than in the standard 24 in. machine, the fulcrum of the lever was not changed and thus the working arm of the main lever is lengthened in relation to the load arm, greatly increasing the power of the ram. In making this change the whole bull gear construction was re-designed.

Two or three years ago a test was made on two Gould & Eberhardt shapers at the University of Michigan, one machine having a V gib ram and the other a square gib ram. The report on these tests stated that the V form of ram was superior in all but one of the points investigated. In the horizontal deflections the square machine had an advantage, but in vertical deflection, wear, general efficiency and convenience, the V shape showed a marked superiority. On the basis of this report the gib on the new machine has been given an angle of 55 deg. instead of 45 deg. previously employed and is able to better withstand the horizontal strains without losing any of the advantages of the V type bearing for vertical strains. At the same time a new construction of gib bearing, which allows a solid metal



Gould & Eberhardt Shaper, Invincible Type.

contact on both sides of the ram bearing, has been adopted. The taper gib is in two parts and may be adjusted from the side, near either the front or back. This adjustment is obtained by means of set screws between the ram bearing and the solid bearing in the frame.

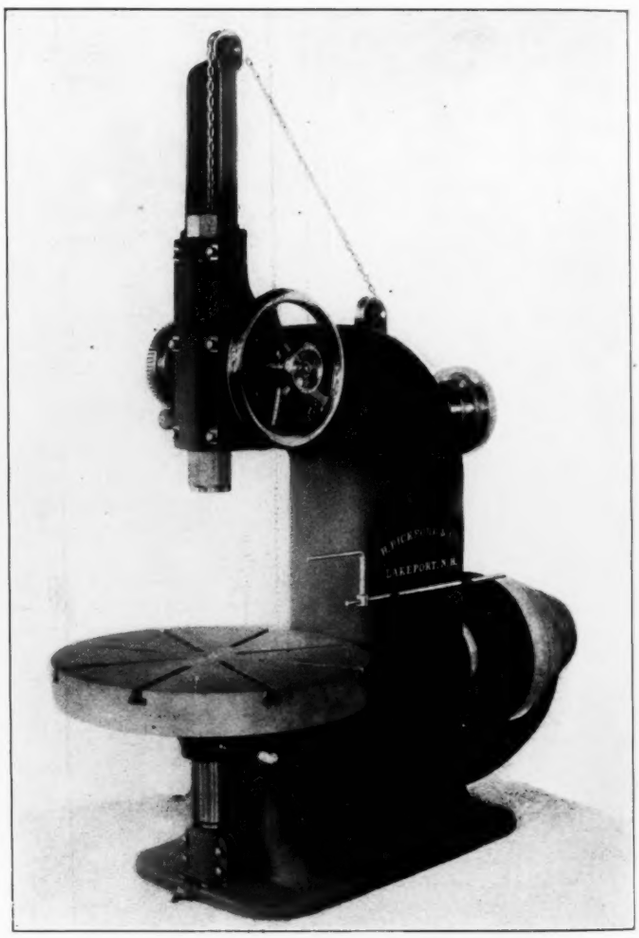
In connection with the construction of the bull gear the overhang of the crank pin was considerably reduced, which further increases the efficiency under heavy cuts. The crank pin is held to the large bull gear by solid V ways, similar to the bearings of the ram. The ratio of the patent "double train gear drive," used on these machines, has been increased by giving the shaper a greater initial speed and increasing the ratio of the gearing. This gives more power to the machine in both single and back gear. The ratio in single gear is 6.64 to 1, and in back gear, 32.06 to 1. Careful attention has been given to the oiling systems for the various moving parts, and ample metal is provided in all of the vital parts to give them the required stiffness. The shaper weighs 4,800 lbs., and is shown in the illustration with a direct connected Reliance variable speed motor, automatic starter and Dynamic brake control.

Locomotive Repairs.—The Pennsylvania Railroad is now employing in its locomotive repair shops an average of 2.7 men for each locomotive owned.

VERTICAL CHUCKING MACHINE

A machine suitable for handling all classes of work requiring a chuck, such as bushings, car wheels, gears, etc., as well as some work which is generally done on a vertical boring mill, has been designed by H. Bickford & Company, Lakeport, N. H. Machines of this type have an advantage over a lathe, particularly on heavy work, since the force of gravity is an aid in centering rather than a hindrance, and the greatly increased rigidity of the tool spindle over the tool post permits the use of much heavier cuts at a higher speed. Because of its simplicity, it is possible to produce a machine in this form, of high class workmanship, which can be sold at a low price.

Most of the features of construction are clearly shown in the



Special Vertical Machine for Chucking Work.

illustration; the tool spindle is octagonal in shape, measuring 5 in. across the flats, and is counterbalanced by a weight inside the frame. The power feed is operated by a large friction worm gear running in oil, which is driven by a feed shaft connected with the main driving shaft by a 1½ in. belt on four-step cone pulleys, giving four feeds.

The table is supported by a large spindle fitted with two large, easily accessible bearings. An adjustable, hardened and ground steel step submerged in oil carries the weight of the table and resists the thrust. The table is driven by planed beveled gears and the driving shaft has three long bearings.

The machine will take work 37 in. in diameter and accommodates a height of 23 in. under the spindle. The spindle has a total movement of 29⅛ in. and the machine occupies a floor space of 7 ft. 6 in. by 3 ft. 1½ in. The extreme height is 8 ft. 5¼ in.

FLANGELESS SHOES AND WEDGES AND IMPROVED DRIVING BOX CONSTRUCTION

BY C. D. ASHMORE,
General Foreman, Chicago and North Western, Clinton, Ia.

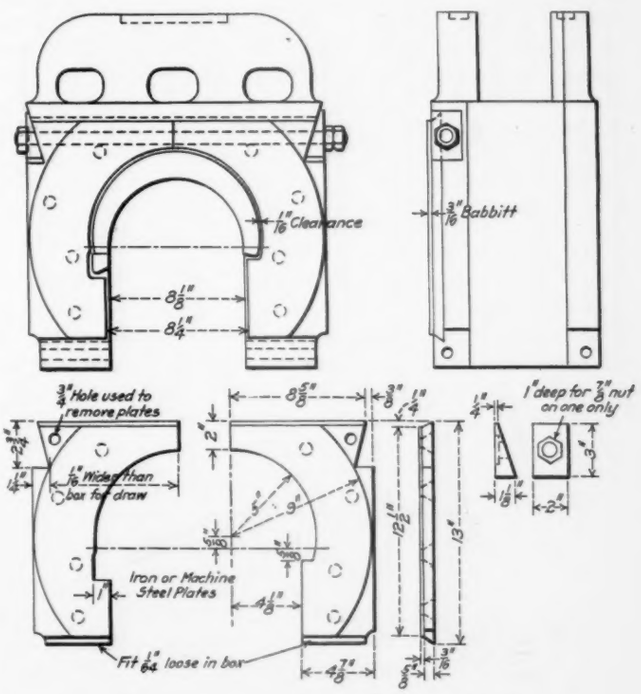
There are 425 driving boxes on the Chicago and North Western arranged for use with the flangeless shoe and wedge, and also provided with a crown brass and a hub liner that can be removed and renewed without dropping the wheels. This construction is being specified on all new locomotives now being built and is being steadily applied to the older power as it goes through the shops. The idea of using the flangeless shoe and wedge originated at the Clinton shops in 1906, and was put in experimental use for a sufficient time to thoroughly prove its advantages before being generally applied. Meanwhile small changes and improvements were made, as service indicated desirable; the latest practice is shown in the accompanying illustrations.

That the opportunity to line down a wedge without taking down the binder and to remove driving box brasses and liners without dropping the wheels, produces a decided saving in time and money is well illustrated by the following comparative costs:

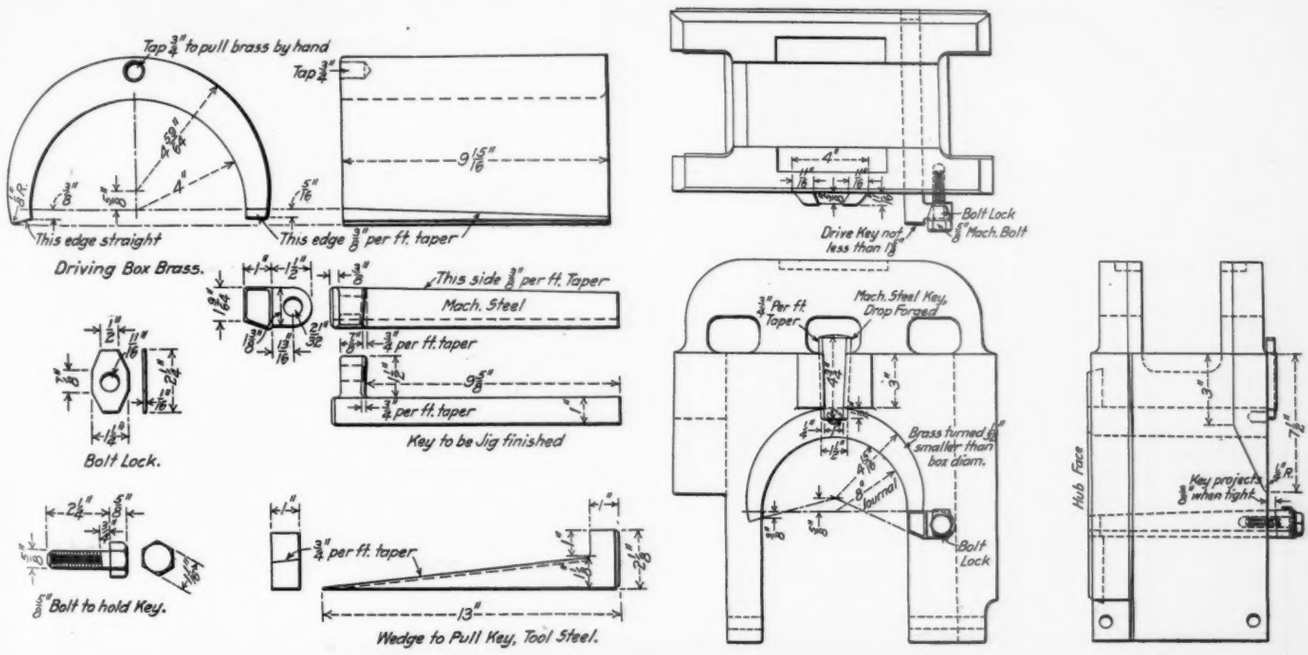
Lateral motion can be taken up in one box by the removal of the facing liners and the application of new ones of increased thickness in one and a half hours at a labor cost of 65 cents, where the same result would cost $6.96 if the wheels had to be dropped.

For lining down a wedge on a heavy locomotive where the binder has to be removed, it was found that the job complete would take about five hours under ordinary circumstances, and would cost $2.85. With the flangeless shoe and wedge and a driving box to suit, this operation now takes about one and a half hours and costs 59 cents for labor. The advantage of the removable brass is illustrated by the fact that two main brasses, 9½ in. x 12 in., on a Pacific type locomotive with Walschaert valve gear can be removed, rebored, liner applied and locomotive again be ready for service in six hours and at a labor cost of $3.95. On an Atlantic type locomotive with Stephenson valve gear, it requires about four hours with a labor cost of $3.10 to perform the same operation on one main brass.

One of the illustrations shows in detail the construction of the removable lateral motion plates which, at the present time, are made of boiler plate faced with babbitt but may also be made of brass if it seems desirable. It will be seen that the plate is in two parts, beveled top and bottom, and fits loosely into a dovetailed recess on the outside face of the driving box. A ⅞ in. bolt with beveled washers which fit into notches in the sides of the plates, holds the plate in place and forces them securely into the upper dovetail in the box. When it is necessary to take up lost motion, the removal of the nuts on one end of the bolt permits the liners to be taken out and replaced


1/16" Clearance
3/16" Babbitt
3/4" Hole used to remove plates
1" deep for 7/8" nut on one only
1/16" Wider than box for draw
Iron or Machine Steel Plates
Fit 1/64" loose in box

Removable Driving Box Side Motion Plates.

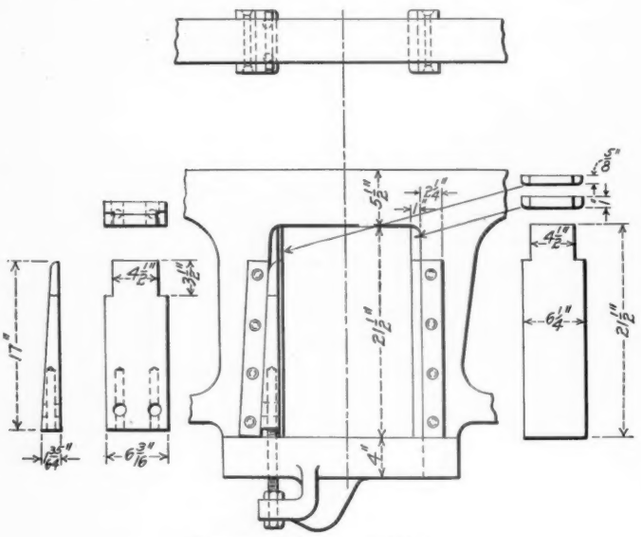

Tap 3/4" to pull brass by hand
This edge straight
This edge 3/8" per ft. taper
Driving Box Brass.
This side 3/8" per ft. Taper
Mach. Steel
3/4" per ft. taper
Key to be Jig finished
Bolt Lock.
Bolt to hold Key.
Wedge to Pull Key, Tool Steel.
Drive Key not less than 1 3/8"
Bolt Lock
7/8" Mach. Bolt
3/4" Per ft. Taper
Mach. Steel Key, Drop Forged
Brass turned 1/16" smaller than box diam.
Bolt Lock
Hub Face
Key projects 3/8" when tight

Removable Driving Box Brass Used on the Chicago & North Western.

with others of the proper thickness, all without dismantling any other part of the locomotive.

The flangeless shoe and wedge are also shown in one of the illustrations, and consist simply of blocks of machinery steel of the same shape and size as the usual shoe and wedge, but without the flanges. Flat pieces of cold rolled, case hardened steel of the proper thickness and width are riveted to the frame jaws to take the place of the flanges. The shoe and wedge blocks are made slightly narrower than the total width over the flanges. This construction makes the labor cost of machining comparatively small and also does away with the constant breakage of flanges. The rivet holes in the plates and the frame are drilled to a jig and extra plates can be carried in stock and be quickly applied. In connection with the flangeless shoe and wedge, part of the inside flange on the wedge side of the driving box is removed and the wedges can be taken out and lined without dismantling any other part of the locomotive.

The removable driving box brass in its earlier form was illustrated in these columns,* and the latest construction is shown herewith. It consists simply of turning the outside of the crown brass 1/32 in. smaller in diameter than the box fit, slotting off one edge of the brass with a taper of 3/8 in. per ft., and installing a suitably shaped steel wedge of the proper thick-



Flangeless Shoe and Wedge.

ness to give a driving fit of at least 1⅝ in., which will produce a pressure between the brass and the box equal to that obtained if the brass was forced in under an hydraulic pressure of 30 tons. The wedge has a lip and is secured to the box by a ⅝ in. stud bolt having a lock nut. As a further safeguard to prevent all possibility of the brasses coming out in case the wedge is broken or works loose, a tapered key is dropped in between suitably cast lugs on the box above the brass and projects over the end of it for a distance of ½ in.

Boxes arranged for use with removable brasses are all carefully slotted with jigs, and the wedges, keys, etc., are all standard and interchangeable. Special jigs are provided for boring the brass, which is done before it is applied to the box. The success obtained from the use of these jigs and standard parts has been such that it is practically never necessary to refit the driving box cellar because of the legs of the box being sprung too much, or too little.

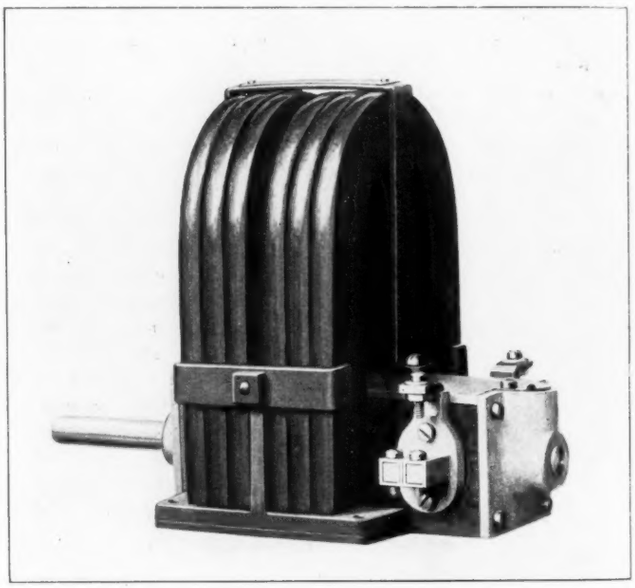
Large Force on Car Repairs.—The Pennsylvania Railroad is now employing 11,500 men on repairs to freight cars. This is one man for every thirteen cars owned by the company.

*See *American Engineer & Railroad Journal*, May, 1911, page 188.

ELECTRIC SPEED INDICATOR

A properly constructed magneto-generator will produce a voltage that varies directly as the speed of its armature, and when such an instrument is connected to a revolving shaft through a belt or gearing and the circuit is closed through a direct current voltmeter, the scale of which indicates revolutions per minute instead of volts, a thoroughly reliable speed indicator is obtained. The scale on the voltmeter can be made to read the number of revolutions of the armature shaft and the percentage reduction or increase given by the belt or gearing can be used as a corrective factor, or different scales can be applied to the meter, and the speed may be obtained direct. Speed indicators of this type have a wide field of application, particularly as the meter can be placed in any desired distant location. In addition to revolutions per minute, the scale on the meter can be made to show feet per minute, percentage fast or slow, cycles per second, miles per hour, etc.

By the use of a graphic recording meter a complete record of the operation of the train or machine is possible, and in this form it is particularly applicable to locomotives. A magneto-



Magneto-Generator Arranged as a Speed Indicator.

generator designed for this purpose and shown in the illustration, is manufactured by the Holtzer-Cabot Electric Company, Chicago, Ill. It is especially arranged for use with meters manufactured by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. This instrument is small, having over-all dimensions of only 6 in. x 10 in. x 10 in., and is strongly constructed.

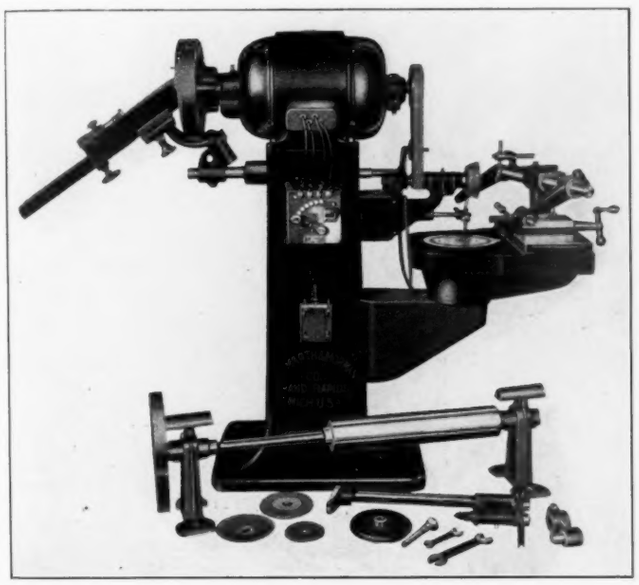
Employees' Life Insurance.—A workman who has been in the employ of the Michigan Stove Company, Detroit, Mich., for thirty days, has his life insured by the company without cost. Married men are insured for $500 each and single men for $250. This is the second corporation to take out such policies and the first manufacturing company.

Telegraphy.—The number of miles of telegraph owned and the number of telegrams transmitted by the Western Union Telegraph Company in recent years has been as follows:

Year.	Miles.	Telegrams.
1907	205,646	74,804,551
1908	208,477	62,371,287
1909	211,513	68,053,439
1910	214,360	75,135,405
1911	219,219	77,780,732

MILLING CUTTER, REAMER AND DRILL GRINDER

A new tool used for grinding milling cutters, reamers and drills has recently been placed on the market by the Wilmarth & Morman Company, Grand Rapids, Mich. It is driven by a one-horsepower motor and will grind face and side milling cutters up to 12 in. in diameter; straight or tapered reamers up to 17 in. long with flutes not over 11½ in. long; angle milling cutters with any angle up to 8 in.; plain milling cutters of any type up to 8 in.; gear cutters up to 5½ in.; hobs up to 5½ in.; forming



New Milling Cutter, Reamer and Drill Grinder.

cutters of any length up to 5½ in. in diameter, and flutes or taps up to 11½ in. long. The machine will take either straight or tapered cylindrical work up to 7¼ in. in diameter and 11½ in. long. The distance between the centers is 17 in. and holes can be ground in tunnel work up to 4 in. deep and of a 10½ in. swing. The drill-grinding attachment is the regular New Yankee non-calipering type, which only requires the drill to be placed in the holder to have it properly adjusted for grinding.

LONG DISTANCE TRUCK RIDER.—On the arrival of a sleeping car from Bukarest, Roumania, at one of the Paris stations, a youth of 20 was found on the trucks underneath who had ridden all the way for 36 hours in that position without food or drink, and was so coated with dust and dirt that it required a resort to the station water supply to make out what sort of an animal he was.

CORROSION OF STEEL PASSENGER CARS.—"In an experimental way the use of calcium chloride applied in fixed receptacles between the outside and inside sheets of steel passenger cars would be worth trying, since it is a powerful moisture absorbing agent and will not harm steel or metals. In all cases the inside finish ought to be applied as tight as possible and all fissures closed."—*A. Copony before the Canadian Railway Club.*

TRANSPORTATION OF CUT FLOWERS IN FRANCE.—The export of fresh cut flowers from the south of France has increased to such an extent that the Paris-Lyons-Mediterranean Railway has been running a special train since October, 1911, to further assist the florists. All the cut-flower cars are assembled at Marseilles and are then directed to their destinations by express. The inauguration of the special train service has considerably shortened the time of transport.

GENERAL NEWS

The roundhouse of the Atchison, Topeka & Santa Fe at San Angelo, Tex., was destroyed by fire on the morning of October 16; estimated loss, $50,000.

The Missouri Pacific has completed the transfer of its hospital property and funds to an organization of its employees. The cash turned over to the men by the company amounted to $193,768.

The Memphis, Dallas & Gulf has been sued to the amount of $1,800 for violations of the safety appliance laws. A suit has also been filed against the Chicago & South Bend at Indianapolis, Ind., for the same reason.

The Chicago Great Western has posted notices in their shops at Oelwein, Ia., as follows: "Unless you are willing to be careful to avoid injury to yourself and fellow workmen don't ask for employment; we don't want careless men in our employ."

A copy of the new manufacturers' standard flange fittings which became effective October 1 may be had by addressing W. H. Douglas, secretary, Committee of Manufacturers on Standardization of Fittings and Valves, 30 Church street, New York.

At an exhibition of drawings at the Toronto Exhibition, the apprentices of the Grand Trunk at Stratford, Ont., took six prizes for mechanical drawing, getting a total of $32 out of $40. The remaining $9 went to the apprentices from Point St. Charles, Que.

The use of the common drinking cup has been prohibited on all interstate railroad trains by a quarantine order issued October 30, by the Secretary of the Treasury. The order was made on the recommendation of Surgeon-General Blue of the Public Health and Marine Hospital service.

The arbitrators who are considering the question of the wages of locomotive enginemen on the eastern roads have resumed their sittings after a recess of a month. It is not expected that a decision will be issued before the middle of next week, the statistical examinations, which are a part of the board's investigation, being still unfinished.

At the annual meeting of the Erie Employees' Relief Association held September 17 at Salamanca, N. Y., a total membership of 3,400 members was reported. The treasury balance to October 1, 1912, was $21,148.76. This association is purely a mutual benefit organization. It has no compulsory fees and is composed entirely of employees of the Erie system in all departments of the service.

The articulated car, which was recently mentioned as being in service on the Boston Elevated Railway, consists of two 4-wheel passenger cars connected by a central compartment which rests on the ends of the two cars and is used only for entrance and exit purposes. The car will traverse 35-ft. curves and is adapted for the pay-as-you-enter feature, the conductor being stationed opposite the doors of the central compartment; all doors are operated by a pneumatic apparatus.

During the year ending June 30, 1912, there were 131 fewer persons injured on the Atchison, Topeka & Santa Fe east of Albuquerque, 18 fewer employees killed and 1,146 fewer employees injured on trains or in shops than in the previous year. There were also 32 less persons killed and 86 less injured in trespassing in crossing accidents, making a total of 50 less killed and 1,363 less injured. During eleven months of the fiscal year a reduction of nearly $250,000 in claims was made on the entire system as compared with the previous year.

The thirty-four million mark in the disbursement of the relief funds of the Pennsylvania Railroad System was passed last month. Exactly $34,119,716.77 has been paid in benefits to employees and their families in the twenty-six years and eight months that the

relief fund has been operative on the Pennsylvania. In September the amount paid from the relief funds on the lines of the Pennsylvania, both east and west of Pittsburgh, totaled approximately $200,000, of which 29 per cent. went to the families of members who died, while the remaining 71 per cent. was paid to members disabled by sickness or otherwise incapacitated for work in the company's service.

The University of Pittsburgh has issued a pamphlet, entitled Bulletin No. 1, giving an outline of the investigation of the smoke nuisance, which is being carried on by the Department of Industrial Research of the university. This investigation, financially provided for by a gift from a Pittsburgh business man, is under the direction of Professor R. K. Duncan, director of the Department of Industrial Research. He has secured the assistance of specialists from other universities and of physicians, architects and other persons specially qualified, in Pittsburgh. Six of these specialists are giving their entire time to the work. It is estimated that the United States, as a whole, suffers a loss of over $500,000,000 yearly in damage to merchandise, defacement of buildings, injury to life, excessive cost of labor, etc., because of imperfect combustion of coal. So far as Pittsburgh is concerned, Professor Duncan intends to determine the amount of this loss as accurately as possible.

A new publication has been started by the newly formed Chamber of Commerce of the United States called the *Nation's Business*. It is printed in the form of a daily newspaper, and in the first issue the object of the paper is described as follows: "The *Nation's Business* is the organ of the Chamber of Commerce of the United States of America and is prepared for the use of editorial writers, commercial organizations and constituent members. The *Nation's Business* will gather for the use of newspapers and organizations current information regarding the development of the nation. Every reader is, therefore, invited to be a correspondent regarding local matters in the financial, agricultural, mining, manufacturing, transportation, distribution and educational fields; also in the professions, the government and altruism. The names of those other than editors, organizations, or constituents who desire to receive the *Nation's Business* regularly will be registered at the rate of $1 for 20 issues." The editor is E. Grosvenor Dawe.

The Erie Railroad has purchased the American Locomotive Company's experimental Pacific type locomotive No. 50,000, which was designed and constructed by the builders at their own expense for the purpose of obtaining information as to the possibilities of increased capacity and improved economy in passenger locomotives for difficult service through the application of the latest knowledge in general proportions, details of design, materials and fuel saving devices. The locomotive was fully described in the January issue of the *American Engineer*, page 5. In service tests it has shown 13 per cent. greater average economy compared with another Pacific of like weight equipped with the same fuel saving devices, though not developed to the same degree, and over 25 per cent. greater economy than one of conventional design. Its success in service last winter on the Erie in maintaining a most difficult schedule under the worst weather conditions experienced in years, demonstrated its exceptional capacity. The influence which this engine has had on subsequent locomotive design marks it as a distinct advance in locomotive engineering.

Statistics have been compiled by the Pennsylvania Railroad showing the extent to which its employees keep themselves from being injured and preserve their health. The number of injured persons on the rolls of the relief department per annum per thousand Pennsylvania employees has decreased from 11 in 1902 to 8.3 in 1911. Accidental deaths per thousand employees has decreased from 4.9 to 1.9, or more than 60 per cent. The number of cases of illness was 35.4 per one thousand employees in 1902 and 29.2 in 1911. Deaths from sickness were 8.5 per thousand employees in 1902 and 7.5 in 1911. These statements cannot be compared with the statements of persons injured which are published by the government, as the Pennsylvania's figures represent the proportion constantly disabled or sick, while the other statistics consider only casualties. The following table compares the Pennsylvania's record with those reported by the Interstate Commerce Commission for the whole country and per Group 2 (New York, New Jersey, Pennsylvania, Delaware and Maryland):

Employees Killed per 1,000 Persons Employed.

	1908.	1905.	1902.
Pennsylvania R. R.	1.8	4.4	4.9
United States	2.37	2.43	2.49
Group 2	2.68	2.82	3.00

The years of the railroad company end on December 31, while the government year ends on June 30, but this probably does not make any serious difference in the meaning of the comparisons.

BOILER INSPECTION RULES

At a general session of the Interstate Commerce Commission, held at its office in Washington, D. C., on September 12, 1912, it was ordered that Rules 29 and 35, as approved in the order of the commission entered June 2, 1911, be amended to read as follows:

Twenty-nine: Siphon.—Every gage shall have a siphon of ample capacity to prevent steam entering the gage. The pipe connection shall enter the boiler direct and shall be maintained steam tight between boiler and gage. The siphon pipe and its connections to the boiler must be cleaned each time the gage is tested.

Thirty-five: Setting of safety valves.—Safety valves shall be set to pop at pressures not exceeding 6 lbs. above the working steam pressure. When setting safety valves two steam gages shall be used, one of which must be so located that it will be in full view of the person engaged in setting such valves; and if the pressure indicated by the gages varies more than 3 lbs. they shall be removed from the boiler, tested, and corrected before the safety valves are set. Gages shall in all cases be tested immediately before the safety valves are set or any change made in the setting. When setting safety valves the water level in the boiler shall not be above the highest gage cock.

It was further ordered that the amendments to Rules 29 and 35 be made effective on and after January 1, 1913.

Professor E. C. Schmidt, in charge of the department of railway engineering of the University of Illinois, has been commissioned by the Japanese government to design a railway dynamometer car for the Imperial Government Railways. The car will be built in this country under the supervision of Professor Schmidt, and is expected to be delivered next spring to the representative of the Japanese government. The car is to be 48 ft. long, 8 ft. 6 in. wide, adapted at present for 3 ft. 6 in. gage, with provision for changing later to 4 ft. 8½ in. gage. It is to be equipped with vacuum brakes, and the design of such details as drawbar, buffers, journal boxes, etc., is to conform to Japanese railway standards. The car is to be of the hydraulic dynamometer type, such as has been developed at the University of Illinois. The recording apparatus will permit the measurement of tractive efforts up to 80,000 lbs., and will provide also for the measurement of speed, time, distance, vibration, buffer thrust, etc. The car and the apparatus will be designed for a maximum speed of 85 m. p. h. An axle generator and storage battery will be provided to supply current for operating the recording apparatus and for lighting purposes. The work has been undertaken at the instance of S. Matsuno, chief of the motive power section of the central division of the Japanese Imperial Government Railways, who has supplied the general specifications for the design.

MEETINGS AND CONVENTIONS

Cleveland Engineering Society.—At a special meeting of the Cleveland Engineering Society held October 22, G. F. Ahlbrant presented an illustrated paper entitled "Ingot Iron Versus Steel." Mr. Ahlbrant is connected with the American Rolling Milling Company, Middletown, Ohio.

Western Railway Club.—At the October meeting a paper was presented by C. M. Larson, assistant chief engineer of the Wisconsin Railroad Commission, on "Headlight Tests." The tests covered both the distance at which an object could be distinguished, and also the effect of the light from the headlight on clear signals. Oil, acetylene gas and electric headlights were compared.

New York Railroad Club.—Liquid Fuel, Its Use and Abuse, was the subject of the paper presented by W. W. Best at the October meeting of the New York Railroad Club. It included the analyses of several different grades of fuel oil and discussed and described different methods of burning oil, both in stationary furnaces and locomotives. Lantern slides showing various types of equipment were used as illustrations by the author.

National Council for Industrial Safety.—The National Council for Industrial Safety was organized by those attending the Co-Operative Safety Congress held at Milwaukee, Wis., recently under the auspices of the Association of Iron and Steel Electrical Engineers. Plans for an organized national campaign for the promotion of industrial safety were adopted and arrangements made for the next safety congress in 1913 in connection with the annual meeting of the Association of Iron and Steel Electrical Engineers. Fred C. Schwedtman, of the National Association of Manufacturers, was elected chairman of the congress.

Southern & Southwestern Railway Club.—The subject of fuel oil for use on railways was quite fully covered by J. F. Ryan of the Texas Oil Company at the September meeting. The action of the oil on the flues and firebox sheets, the proper method of eliminating black smoke and handling oil burning apparatus on a locomotive as well as instructions for engineers and firemen, etc., were given in the paper. The proper method of storage and some data as to oil consumption in boilers and furnaces under different conditions were also included. The discussion consisted largely of questions and answers between the members and Mr. Ryan.

Chicago Car Foremen's Association.—The annual meeting of the Car Foremen's Association of Chicago was held at the Karpen building on the evening of October 14. After a short business session for the election of officers the programme included a vaudeville entertainment, dancing and a buffet luncheon. The officers elected were as follows: President, F. C. Schultz, chief joint inspector, Chicago Interchange Bureau; first vice-president, J. W. Senger, master car builder, Lake Shore & Michigan Southern; second vice-president, Geo. F. Laughlin, general superintendent, Armour Car Lines; treasurer, M. F. Covert, assistant master car builder, Swift Refrigerator Transportation Company; secretary, Aaron Kline.

American Society of Mechanical Engineers.—The annual meeting, December 3-6, 1912, promises to be one of considerable interest to railway men. The committee on meetings has recently appointed a number of sub-committees, among which is one on railroads. This sub-committee, with E. B. Katte as chairman, consists of the following members: G. M. Basford, W. G. Besler, A. H. Ehle, T. N. Ely, W. F. M. Goss, A. L. Humphrey, W. F. Kiesel, W. B. Potter, N. W. Storer, H. H. Vaughan and R. V. Wright. On Thursday morning, December 5, simultaneous sessions will be held under the direction of the sub-committees on railroads, iron and steel, and cement manufacture. Papers on the Proper Selection of Steam Locomotives and Train Lighting will be presented and discussed at the railroad session, and it is also expected that a paper on the Electric Locomotive Problem will be presented.

R. R. Y. M. C. A. Conference.—The fourteenth annual conference of the Railroad Department of the Young Men's Christian Association of North America was held in Chicago October 3, 4, 5 and 6. Nearly 2,000 railway men and delegates from all parts of the United States and Canada were present, including 100 prominent railway officials and executives. H. U. Mudge, president, Chicago, Rock Island & Pacific, acted as chairman of the committee on local arrangements. Addresses were made by W. A. Garrett, vice-president, Chicago Great Western, who spoke of the importance of the railroad department of the Y. M. C. A. to the railways. Other speakers during the conference were G. W. Stevenes, president of the Chesapeake & Ohio; B. F. Bush, president of the Missouri Pacific and Denver & Rio Grande; John Carstensen, vice-president of the New York Central Lines. Cyrus H. McCormick, president of the International Harvester Company; Miss Helen Miller Gould and W. G. Lee, president Brotherhood of Railway Trainmen.

Canadian Railway Club.—At the September meeting, A. Copony, chief draftsman of the car department of the Grand Trunk, Montreal, presented a paper on Suggestions and Discussions from Steel Passenger Cars. This is one of the most extensive discussions on the subject that has appeared and practically all the more important problems are analyzed. Mr. Copony presents strong arguments in favor of the single deck or, "turtle back" car, claiming that, in this form, a car can be built which will be lighter, easier heated and ventilated, cheaper to construct and more attractive to the traveling public in every way. He advocates the use of spot welding in place of riveting throughout the whole structure. Considerable attention is given to the matter of corrosion, especially on the inside surface of the outside steel sheets, and several novel suggestions are made in this connection. The possibility of using roller bearings is considered and the importance of the slip, due to the difference in the diameters of the wheels on the same axle, is shown to be greater than is usually assumed. Insulation, inside finish, ventilation, sanitation, etc., are each given attention in the paper. A table containing the general data, including weight, type of insulation, heating, lighting and ventilation systems, etc., of twenty-four all steel passenger cars, forms an appendix. In the discussion, there was considerable opposition to the author's advocacy of the single deck type of car.

National Machine Tool Builders' Association.—The eleventh annual convention of this association was held at the Hotel Astor, New York, October 16-18. There was a large attendance and very active interest in the proceedings. The following papers were presented for discussion: Export Trade, by W. A. Vialle, Brown & Sharpe Manufacturing Company, Providence,

RAILROAD CLUB MEETINGS

Club.	Next Meeting.	Title of Paper.	Author.	Secretary.	Address.
Canadian	Nov. 12	Terminals	L. C. Fritch	Jas. Powell	Room 13, Windsor Hotel, Montreal.
Central	Nov. 8	Brake Operation of Long Freight Trains	John P. Kelly	H. D. Vought	95 Liberty St., New York.
New England	Nov. 12	Electric Installation on a Battleship	J. J. Crain	Geo. H. Frazier	10 Oliver Bldg., Boston, Mass.
New York	Nov. 15	Operation of Superheater Locomotives	G. E. Ryder	H. D. Vought	95 Liberty St., New York.
Northern				C. L. Kennedy	401 Superior St., Duluth, Minn.
Pittsburgh				J. B. Anderson	Union Station, Pittsburgh, Pa.
Richmond	Nov. 11	Improved Combustion of Fuel	W. L. Ray	F. O. Robinson	C. & O. Ry., Richmond, Va.
S'th'n & S. West'n	Nov. 21	History and Late Improvements of Locomotive Fireboxes		A. J. Merrill	218 Grant Bldg., Atlanta, Ga.
St. Louis	Nov. 8	The St. Louis Terminals—Up to Date	Dr. Wm. Taussig	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Nov. 19	The Telpherage System for Shops and Terminals	H. M. L. Harding	Jos. W. Taylor	390 Old Colony Bldg., Chicago.
Western Canada	Nov. 11	Layout of Yards	L. G. Legrand	W. H. Rosevear	P. O. Box 1707, Winnipeg, Man.

R. I.; The Use of an Association Catalog in the Development of Foreign Markets, by Stanley H. Bullard, Bullard Machine Tool Company, Bridgeport, Conn.; How United States Patents Might Be Made of Greater Value to the Patentees, by Samuel W. Banning, Banning & Banning, Chicago; What We Should Do in the Way of Influencing Tariff Legislation, by Frederick W. Grier, Cincinnati Milling Machine Company, Cincinnati, Ohio; and How Could the Association Be Benefited by the Formation of a Mechanical Section, by E. J. Kearney, Kearney & Trecker Company, Milwaukee, Wis. The question of the formation of a mechanical section of the association was referred to a special committee for further investigation. Again considering the advisability of changing the name, which was first brought up at the semi-annual meeting at Atlantic City, it was resolved to retain the present title. The following officers were elected for the ensuing year: E. P. Bullard, president; A. T. Barnes, first vice-president; R. K. LeBlond, second vice-president; A. E. Newton, treasurer, and C. L. Taylor, secretary.

Railway Business Association Dinner.—The fourth annual dinner of the Railway Business Association will be held December 19, at the Waldorf-Astoria Hotel, New York. The speakers will be James J. Hill and the Hon. W. L. Mackenzie King, former Canadian minister of labor. Mr. Hill will discuss the needs of the country for more and better railway facilities and the financial ability of the roads to meet those needs. At this juncture, when the country is having a painful reminder of the inefficiency of carrying facilities, Mr. Hill's acceptance, changing his previous arrangements in order to be in the United States for the dinner, is a high compliment to this association as a movement and as an organization which provides annually a striking occasion for the delivery of important pronouncements. Mr. King is regarded as one of the highest authorities in the world on the relations of the public to labor disputes. He is the author of the much discussed Canadian Industrial Disputes Investigation Act, the basis for a law recently enacted by the Union of South Africa, and now under investigation for use in England. Mediation between railways and their employees has formed a large part of the operations under the Canadian act, so what Mr. King may say will have special interest for American business men. There will be but two speakers and the dinner this year will begin promptly at 7 o'clock. Instead of laying between 800 and 900 covers as heretofore, the seats will be restricted to 633, in order to be sure that every table will be within earshot of the speakers.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass. 1913 convention to be held at St. Louis, Mo.

American Railway Master Mechanics' Assoc.—J. W. Taylor, Old Colony building, Chicago.

American Railway Tool Foremen's Association.—A. R. Davis, Central of Georgia, Macon, Ga.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Annual meeting, December 3-6, Engineering Societies' Building, New York. Railroad session, Thursday morning, December 5.

Car Foremen's Association of Chicago.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, Chicago.

International Railway Fuel Association.—C. G. Hall, McCormick building, Chicago.

International Railway General Foremen's Association.—William Hall, Chicago & North Western, Escanaba, Mich.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, Lima, Ohio.

Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty St., New York.

Master Car Builders' Association.—J. W. Taylor, Old Colony building, Chicago.

Master Car and Locomotive Painters' Assoc. of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL.

G. H. Bussing has been appointed superintendent of motive power of the Mexico North Western, with headquarters at Madera, Chih., Mexico.

R. L. Chandler has been appointed supervisor of piecework of the New York Central & Hudson River, and will have supervision of the methods and practice in connection with piecework in the locomotive and car departments, reporting to the superintendents of motive power and rolling stock respectively. The position of general inspector of shops has been abolished.

J. R. Gould, general superintendent of motive power of the Chesapeake & Ohio, and the Chesapeake & Ohio of Indiana, with office at Richmond, Va., has changed his title to superintendent of motive power. The position of superintendent of motive power on each general division is discontinued, and C. H. Terrell, superintendent of motive power at Huntington, W. Va., has been appointed assistant superintendent of motive power, with office at Richmond, and W. P. Hobson, superintendent of motive power at Covington, Ky., has been appointed master mechanic of the Cincinnati division. H. M. Brown, master mechanic at Covington, Ky., has been appointed shop superintendent at Huntington, W. Va.

J. T. Johnston has been appointed assistant general boiler inspector of the Atchison, Topeka & Santa Fe Coast Lines, with headquarters at Los Angeles, Cal., vice Gus Mihleisen, assigned to other duties.

W. L. Kellogg, superintendent of motive power of the Pere Marquette, has removed his headquarters from Detroit, Mich., to Wyoming.

George P. Kempf has been appointed engineer of tests of the Chicago, Milwaukee & St. Paul, succeeding R. H. Morrison, resigned.

A. M. McGill, superintendent of the Sayre, Pa., shops of the Lehigh Valley, has been appointed assistant superintendent of motive power, with office at South Bethlehem, Pa.

James Riley, electrical engineer and superintendent motive power and equipment of the Choctaw Railway & Lighting Company, McAlester, Okla., has been appointed electrical engineer of the Missouri, Kansas & Texas, with headquarters at Parsons, Kan.

W. L. Robinson, road foreman of engines of the Baltimore division of the Baltimore & Ohio, at Baltimore, Md., has been promoted to supervisor of fuel consumption.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

E. Becker, master mechanic of the Northern Wisconsin and Lake Shore divisions of the Chicago & North Western, has been appointed division master mechanic at Escanaba, Mich., succeeding F. Slater, transferred.

Raymond E. Bell has been appointed master mechanic of the Galveston division of the Gulf, Colorado & Santa Fe, with headquarters at Galveston, Tex.

J. H. Bender has been appointed master mechanic for the receivers of the Denver, Laramie & Northwestern, with headquarters at Utah Junction (Denver), Colo., to succeed E. Nedro, resigned.

W. A. BLACK has been appointed locomotive foreman of the Grand Trunk, with headquarters at Coteau Junction, Que., vice L. J. McLaughlin, transferred.

A. BROWN has been appointed locomotive foreman of the Canadian Pacific, with headquarters at Fort William, Ont., vice A. McArthur, transferred.

R. W. BROWN, an engineer on the Illinois division of the Baltimore & Ohio Southwestern, has been appointed road foreman of engines of the Indiana division of the Cincinnati, Hamilton & Dayton, with headquarters at Indianapolis, Ind.

CHARLES BROWN has been appointed locomotive foreman of the Canadian Pacific, with headquarters at North Bend, B. C., vice W. E. Hayward, transferred.

F. L. CARSON has been appointed master mechanic of the San Antonio & Aransas Pass, with headquarters at Yoakum, Tex.

W. A. CHAMBERLIN has been appointed master mechanic of the Pere Marquette, with headquarters at Saginaw, Mich., vice F. C. Pickard, resigned.

J. F. HILL, shop superintendent of the Wheeling & Lake Erie at Brewster, Ohio, has been appointed master mechanic, with headquarters at Brewster, succeeding J. E. O'Hearne, resigned.

HARRY M. HUTSON has been appointed division master mechanic of the Baltimore & Ohio, with headquarters at Grafton, W. Va.. He was born in 1869 at Piedmont, W. Va., and was graduated from the Allegheny County Academy, Cumberland, Md., in 1886. The same year he entered the service of the Baltimore & Ohio as machinist apprentice at Piedmont. He left the Baltimore & Ohio four years later to take up mechanical drawing at the Scranton School, and one year later returned to the service of the Baltimore & Ohio and then held various positions in the mechanical department until his appointment as machine shop foreman at Cumberland. Later he was engine house foreman at Keyser, W. Va., until February 14, 1912, when he was made general foreman, at Grafton.

H. M. Hutson.

A. MCARTHUR has been transferred to Sutherland, Sask., as locomotive foreman of the Canadian Pacific, vice J. Sindall, transferred.

C. A. MCCARTHY has been appointed master mechanic of the Indian Territory division of the Chicago, Rock Island & Pacific, with headquarters at Shawnee, Okla., vice W. B. Embury, transferred.

M. J. MCDONALD has been appointed trainmaster and road foreman of equipment of the Chicago, Rock Island & Pacific, with headquarters at Trenton, Mo., and with jurisdiction over subdivision 31.

L. J. MCLAUGHLIN, locomotive foreman of the Grand Trunk at Coteau Junction, Que., has been transferred to Brockville, Ont.

Z. B. MANSFIELD has been appointed acting road foreman of equipment of the Chicago, Rock Island & Pacific, with jurisdiction over the entire Indian Territory division.

F. C. PICKARD has been appointed master mechanic of the Buffalo division of the Delaware, Lackawanna & Western, with office at East Buffalo, N. Y., succeeding F. G. Colwell, resigned.

JOHN R. REEVES has been appointed traveling engineer of the Guayaquil & Quito, Ecuador, succeeding F. B. Wilmot, resigned.

J. C. RHODES has been appointed road foreman of equipment of the Chicago, Rock Island & Pacific, at Eldon, Iowa, with jurisdiction over subdivisions 30 and 30A.

E. SCHULTZ, roundhouse foreman of the Chicago & North Western at Milwaukee, Wis., has been appointed master mechanic of the Northern Wisconsin and Lake Shore divisions, with headquarters at Green Bay, Wis., succeeding E. Becker, transferred.

E. C. SHIPLEY has been appointed road foreman of engines of the Baltimore division of the Baltimore & Ohio.

J. C. SHREEVE has been appointed master mechanic of the Joliet division of the Elgin, Joliet & Eastern Railway, with headquarters at Joliet, Ill., and jurisdiction over the Joliet shops and points north of Joliet.

R. W. SIVERS has been appointed acting road foreman of equipment of the Chicago, Rock Island & Pacific, at Trenton, Mo., and has jurisdiction over subdivisions 32, 32A, 32B, 33 and 33A.

F. SLATER, division master mechanic of the Chicago & North Western at Escanaba, Mich., has been transferred to Kaukauna, Wis., succeeding W. Hutchinson, deceased.

C. E. STEWART has been appointed locomotive foreman of the Grand Trunk Pacific at Biggar, Sask., in charge of locomotive and car departments, vice G. Carruthers, assigned to other duties.

J. WHITEFORD has been appointed master mechanic of the Illinois Central, with headquarters at Centralia, Ill.

T. WINKEL has been appointed master mechanic of the Gulf division of the International & Great Northern, with headquarters at Palestine, Tex.

CAR DEPARTMENT

B. F. CLOUD has been appointed car inspector of the Chicago, Rock Island & Pacific, with headquarters at Wilburton, Okla.

J. W. CROUCH has been appointed foreman of the coach shops of the St. Louis & San Francisco, at the Springfield, Mo., North shops.

GEORGE B. FORSYTHE has been appointed assistant foreman of the car department of the Pennsylvania Lines West of Pittsburgh, with headquarters at Conway, Pa., vice W. A. Guy, promoted.

J. F. GILBERT has been appointed car foreman of the Atchison, Topeka & Santa Fe at Waynoka, Okla., vice F. E. Armstrong.

JAMES HALL, assistant general foreman of the car department of the Southern Pacific, at Sacramento, Cal., has been appointed general car foreman of the Coast division, with office at San Francisco, Cal., succeeding D. D. McRae, master car repairer, transferred.

A. KESTERSON has been appointed rip track foreman of the St. Louis & San Francisco, with headquarters at the Springfield, Mo., North shops, succeeding J. H. Hoffman, assigned to other duties.

GEORGE KING has been appointed car inspector of the Chicago, Rock Island & Pacific at Pratt, Kan., vice Charles Lambert, resigned.

Charles O. Kroft has been appointed car foreman of the Atchison, Topeka & Santa Fe at Wellington, Kan.

F. C. Linn, general car foreman of the San Antonio & Aransas Pass, has been appointed master car builder, with headquarters at Yoakum, Tex.

J. H. Macha has been appointed car foreman of the Atchison, Topeka & Santa Fe, at Shawnee, Okla., vice C. W. Rice, transferred to other duties.

E. J. Shremp has been appointed assistant freight car builder foreman of the Pennsylvania Lines West of Pittsburgh, with headquarters at Conway, Pa., vice J. A. Shremp, promoted.

Jos. A. Shremp has been appointed car builder freight foreman of the Pennsylvania Lines West of Pittsburgh, with headquarters at Conway, Pa., vice G. B. Forsythe, promoted.

E. W. Venamon has been appointed car foreman of the Chicago, Rock Island & Pacific, with headquarters at El Dorado, Ark., vice E. W. Martin, assigned to other duties.

A. A. Wagner has been appointed coach yard foreman of the Chicago, Rock Island & Pacific, with headquarters at Valley Junction, Iowa.

SHOP AND ENGINE HOUSE

Harry Adams, foreman of the San Antonio & Aransas Pass at Kennedy, Tex., has been promoted to the position of division foreman, with headquarters at Houston, Tex.

J. W. Adams has been appointed general foreman of the Baltimore & Ohio shops at Mt. Clare, Baltimore, Md.

N. S. Airhart has been appointed general foreman of the locomotive department of the Rock Island Lines, with office at Cedar Rapids, Iowa, vice G. W. Cuyler, resigned.

Joseph Walter Appleby, division foreman of the San Antonio & Aransas Pass at Houston, Tex., has been appointed foreman of the motive power and car department at Corpus Christi, Tex.

G. A. Belcher, roundhouse foreman of the Atchison, Topeka & Santa Fe, at La Junta, Colo., has been transferred to Deming, N. M., as roundhouse foreman.

T. Bertram, shop foreman of the Canadian Pacific at Moose Jaw, Sask., has been transferred to Revelstoke, B. C.

F. T. Chase has been placed in charge of the shops of the Missouri, Kansas & Texas, at Smithville, Tex.

Floyd G. Clark, night assistant roundhouse foreman of the Chicago & North Western at East Clinton, Ill., has been promoted to the position of night roundhouse foreman at the same place.

G. W. Clark has been appointed locomotive foreman of the Grand Trunk System at the new roundhouse terminal at St. Lambert, Que.

P. Coniff has been appointed assistant superintendent of shops of the Baltimore & Ohio, with headquarters at Mt. Clare, Baltimore, Md.

P. I. Costello, night roundhouse foreman of the Atchison, Topeka & Santa Fe, at La Junta, Colo., has been appointed foreman, with headquarters at Las Vegas, N. M.

J. D. Costello has been appointed erecting foreman of the Atchison, Topeka & Santa Fe, at Clovis, N. M., vice E. H. Reynolds, resigned.

P. S. Fellows has been appointed tool foreman of the Pennsylvania shops at Renovo, Pa.

P. L. Gardner has been appointed foreman of the blacksmith shop of the Trinity & Brazos Valley, with headquarters at Teague, Tex., succeeding T. F. O'Leary, resigned.

B. A. Eldridge, of Argentine, Kan., has been appointed general foreman of the Atchison, Topeka & Santa Fe, at Arkansas City, Kan., vice E. P. Gray, who is absent on account of illness.

Thomas Grant, tool foreman of the Delaware & Hudson at Oneonto, N. Y., has been transferred to the company's new shops at Watervliet, N. Y.

Paul D. Hamilton, machinist on the Atchison, Topeka & Santa Fe has been appointed night roundhouse foreman, with headquarters at La Junta, Colo., vice P. I. Costillo, transferred to Las Vegas, N. M.

E. C. Hause has been appointed general foreman of the Georgia & Florida, with headquarters at Douglas, Ga.

W. E. Hayward, locomotive foreman of the Canadian Pacific at North Bend, B. C., has been appointed roundhouse foreman at Vancouver, B. C.

H. Hood has been appointed roundhouse foreman of the Cotton Belt, with headquarters at Tyler, Tex.

W. F. Howard has been promoted from gang foreman to machine foreman of the Atchison, Topeka & Santa Fe, with headquarters at Cleburne, Tex.

C. E. Johnston, machinist on the erecting floor of the Atchison, Topeka & Santa Fe, at San Bernardino, Cal., has been appointed night roundhouse foreman at Bakersfield, Cal.

John S. Jones, roundhouse foreman of the Chicago & North Western at East Clinton, Ill., has been promoted to the position of roundhouse foreman at Clinton, Ia., succeeding W. A. Egan, resigned.

A. H. Karter, machinist on the St. Louis Southwestern, has been promoted to the position of machine foreman, with headquarters at the new shops which are now nearing completion at Pine Bluff, Ark.

Henry Lewis has been appointed machine foreman of the Atchison, Topeka & Santa Fe, at Clovis, N. M., vice William Barnes.

H. L. McLaw has been appointed roundhouse foreman of the Missouri, Kansas & Texas at Greenville, Tex.

W. O. Morton has been appointed roundhouse foreman of the Chicago, Rock Island & Pacific, at Forty-seventh street, Chicago, vice T. E. McQuade, assigned to other duties.

Harry W. Mosley has been appointed assistant general foreman of the Erie shops at Hornell, N. Y., vice H. W. Sasser, transferred.

T. H. Nanney, foreman of the erecting shop of the Buffalo & Susquehanna, has been appointed general foreman at Galeton, Pa.

George E. Parker, foreman boilermaker of the Chicago & Eastern Illinois, at Villa Grove, Ill., has been appointed foreman boilermaker of the El Paso & Southwestern, with headquarters at Douglas, Ariz., vice M. J. Young, resigned.

Bernard R. Reynolds, engine inspector of the Atchison, Topeka & Santa Fe, has been appointed day roundhouse foreman, with headquarters at La Junta, Colo., vice G. A. Belcher, transferred to Deming, N. M.

D. G. Roberts, formerly master smith of the Delaware & Hudson at Oneonto, N. Y., has been appointed in the same capacity at the new shops at Watervliet, N. Y.

William Sapp has been appointed roundhouse foreman of the Atchison, Topeka & Santa Fe, with headquarters at Sweetwater, Tex., vice J. A. Whithurst, resigned.

Merton E. Sargent, night roundhouse foreman of the Chicago & North Western at East Clinton, Ill., has been promoted to

the position of assistant day roundhouse foreman, at the same place.

ARTHUR SEAL, machinist and assistant roundhouse foreman of the Buffalo & Susquehanna, has been appointed erecting shop foreman, with headquarters at Galeton, Pa.

J. C. SEEGER has been appointed superintendent of the shops of the Lehigh Valley at Sayre, Pa.

CHARLES SHAYNE has been appointed roundhouse foreman of the Erie, with headquarters at Huntington, Ind.

J. SINDALL, locomotive foreman of the Canadian Pacific at Sutherland, Sask., has been transferred to Cranbrook, B. C., as shop foreman.

CHARLES F. SMITH has been appointed erecting foreman of the Chicago, Rock Island & Pacific, at Forty-seventh street, Chicago, vice Edward Schell, resigned.

T. F. SULLIVAN has been appointed assistant roundhouse foreman of the Atchison, Topeka & Santa Fe, with headquarters at Cleburne, Tex.

H. P. SYFAN, night roundhouse foreman of the Denver & Rio Grande at Alamosa, Colo., has been transferred to Chama, N. M.

W. H. VOIGT has been appointed night roundhouse foreman of the Trinity & Brazos Valley, with headquarters at Teague, Tex.

W. H. WALKER has been appointed locomotive foreman of the Grand Trunk System at Turcot, Can., vice J. D. Scott, resigned.

W. F. WALLACE, assistant roundhouse foreman of the Atchison, Topeka & Santa Fe, has been appointed gang foreman at Cleburne, Tex., succeeding W. F. Howard, promoted.

L. E. WALLIS has been appointed erecting foreman of the Atchison, Topeka & Santa Fe shops at Cleburne, Tex.

EDGAR E. WHITEBREAD, day assistant roundhouse foreman of the Chicago & North Western at East Clinton, Ill., has been promoted to the position of night roundhouse foreman, with headquarters at Clinton, Ia.

PURCHASING AND STOREKEEPING

F. A. STARR, foreman of the coach shops of the St. Louis & San Francisco, at the Springfield, Mo., North shops, has been appointed general foreman of the storeroom.

R. O. WOODS has been appointed division storekeeper of the Mobile & Ohio, with headquarters at Meridian, Miss., with supervision over mechanical department material at Meridian, and also of roadway and bridge building material on M. and M. district.

OBITUARY

ROBERT H. ROGERS, at one time an associate editor of the *American Engineer & Railroad Journal,* died at a private hospital in New York on October 23. Mr. Rogers was a graduate of the Baltimore Polytechnic Institute, and entered railway service as a machinist's apprentice on the Baltimore & Ohio. In 1895 he was made general piece work inspector of that system, and was later roundhouse foreman at the Pittsburgh terminal. He resigned this position to become shop foreman of the Mexican Central at Mexico City, and in 1898 joined the staff of the *Philadelphia Times* and *North American.* Later he was appointed assistant master mechanic of the Baltimore & Ohio at Mt. Clare, Md., and in February, 1905, was appointed master mechanic on the New York, New Haven & Hartford at South Boston. On January 1, 1908, he undertook a general and thorough inspection of the locomotive equipment of the Erie, on the completion of which he spent several months in foreign countries studying locomotive practice.

NEW SHOPS

ATCHISON, TOPEKA & SANTA FE.—Plans are being prepared for the new shops at Albuquerque, N. M. The estimated cost is $1,600,000. It is also reported that new shops and an engine house will be built at Wichita, Kan.

BALTIMORE & OHIO.—A contract has been awarded to P. Farrel, Cincinnati, Ohio, for the construction of an engine house, turntable, and sand house at Somerset, Pa.

CANADIAN PACIFIC.—A machine shop will be erected at Wilkie, Sask.

CHICAGO & ALTON.—An additional engine house will be built at Chicago, Ill.

CHICAGO, MILWAUKEE & PUGET SOUND.—It is reported that a site has been purchased at Lewistown, Mont., for shops and terminal facilities.

CHICAGO, MILWAUKEE & ST. PAUL.—An engine house and blacksmith shop will be built at Bensonville, Ill.

CHICAGO, PEORIA & ST. LOUIS.—A contract has been placed for car and machine shops at Springfield, Ill., the estimated cost to be $50,000.

CHICAGO, ROCK ISLAND & PACIFIC.—The work on the 20-stall engine house, turntable, cinder pit, machine shops, power house, water plant, coaling station and divisional terminal facilities at Manly, Ia., will begin in the early part of next year. Bids are also being asked for by this company for a one-story machine shop of structural iron and brick to be built at the same place. Plans are being made for the erection of a large engine house and repair shops at Des Moines, Ia. A two-story wood-working shop in the pattern department is to be added to the Silvis shops at Moline, Ill.

CINCINNATI, NEW ORLEANS & TEXAS PACIFIC.—An engine house and coaling station of concrete construction will be built at Ludlow, Ky.

CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS.—A brick engine house will be built at Harrisburg, Ill., to be one story high, 200 ft. long and 100 ft. wide, and new car shops will be erected at Danville, Ill.

GALLATIN VALLEY.—Arrangements are being made for an engine house at Bozeman, Mont.

GULF, COLORADO & SANTA FE.—The plans for the improvement at Brownwood, Tex., include $45,000 for a 12-stall engine house; $11,000 for a standard 45-ft. turntable; $10,000 for a machine shop; $8,500 for a car shop; $8,000 for a power house and $5,500 for a sand house.

LAKE SHORE & MICHIGAN SOUTHERN.—It is reported that the erection of the large shops at Elkhart, Ind., will begin early next year and be completed by the end of the year.

MIDLAND VALLEY.—The engine house and repair shop that were recently destroyed by fire at Pawhoska, Okla., will be rebuilt and re-equipped.

MISSOURI, KANSAS & TEXAS.—Plans have been prepared for the construction of an engine house at Mokane, Mo. The shops at Houston, Tex., will be moved to a 49-acre tract of land recently purchased between Cottage Grove and Eureka.

NASHVILLE, CHATTANOOGA & ST. LOUIS.—The site for the new shops at Paducah, Ky., has been obtained and the construction work will begin in the near future.

NORTHERN PACIFIC.—It is expected that a 40-stall engine house, machine shops and division offices will be built at Carlton, Minn.

SOUTHERN PACIFIC.—Shops will be established at Alpine, Tex., for joint use with the Kansas City, Mexico & Orient.

WABASH.—A contract has been awarded to C. W. Gindele & Company, Chicago, for the concrete foundation, brick and mill work on the locomotive repair shop to be built at Decatur, Ill.

SUPPLY TRADE NOTES

The National Tube Company, Pittsburgh, Pa., has opened a branch office at Boston, Mass.

The National Tube Company, Pittsburgh, Pa., has opened a branch office at St. Paul, Minn.

Mark A. Ross has resigned as treasurer and director of the Pyle-National Electric Headlight Company, Chicago.

William Horace Corbin, vice-president of The Joseph Dixon Crucible Company, Jersey City, N. J., died on Wednesday, September 25.

E. G. Buckwell, secretary and manager of sales of the Cleveland Twist Drill Company, Cleveland, Ohio, has gone abroad on a two months' business trip.

The Preston Car & Coach Company, Preston, Ont., has secured the Canadian manufacturing rights of the gasoline cars recently tried out on the Canadian Northern.

E. F. G. Meisinger has been appointed representative of the railroad department of S. F. Bowser & Co., Ft. Wayne, Ind., for the territory west of the Rocky mountains.

S. F. Bowser & Company, Fort Wayne, Ind., announce that E. H. Briggs has been added to their sales staff in the railroad department. He will cover the southwest territory.

The Republic Iron & Steel Company, Youngstown, Ohio, has resumed the payment of the 1¼ quarterly dividend on its preferred stock, which has been omitted since January 1, 1912.

The Commercial Acetylene Company, New York, has changed its name to the Commercial Acetylene Railway Light & Signal Company. The new name better explains the activities of the company.

The Railroad Supply and Equipment Club in the Karpen building, Chicago, has made arrangements for a series of lectures on mechanical subjects to be given in its assembly hall on Saturday evenings.

The Titanium Alloy Manufacturing Company, because of the rapidly increasing demand for its products, has found it necessary to remove its general sales department to the works at Niagara Falls, N. Y., and has created a district office at Pittsburgh, Pa.

At a meeting of the directors of the American Locomotive Company, held on October 31, 1912, all of the officers of the company were re-elected with the exception of H. F. Ball, vice-president, who declined re-election. No successor to Mr. Ball was elected.

W. D. Matthews, a director of the Canadian Pacific Railway Company, has been elected a vice-president of the Canadian General Electric Company to fill the vacancy caused by the death of H. P. Dwight, president of the Great North Western Telegraph Company.

C. A. Carscadin, formerly vice-president of the Kirby Equipment Company, Chicago, and representative of the Globe Seamless Steel Tube Company, of Milwaukee, has been appointed general sales agent of the Spencer Otis Company, with offices in the Railway Exchange, Chicago.

The Griffin Wheel Company, of Chicago, is to be reorganized under Massachusetts laws. The present Illinois corporation has a capitalization of $8,000,000. The new company will have an authorized issue of $12,000,000 common stock, of which $9,500,000 will be issued, and $9,000,000 preferred stock, of which $6,000,000 will be issued.

William Wharton, Jr. & Company, Inc., Philadelphia, Pa., announce the merger of its interests and the Taylor Iron & Steel Company, of High Bridge, N. J. It will continue under the name of Wm. Wharton, Jr. & Company, Inc., while the Taylor Iron & Steel Company will hereafter be known as the Taylor-Wharton Iron & Steel Company.

The Locomotive Superheater Company, New York, is building a plant at East Chicago, in the neighborhood of the property which has been acquired by the locomotive builders for western plants, for the manufacture of superheaters for application to old locomotives. It is expected that the plant will be placed in operation about the first of the year.

The regular quarterly dividend of 2½ per cent. has been declared by the Independent Pneumatic Tool Company of Chicago. It is reported that the business of the company for the fiscal year ending September 30 will show an increase of over 25 per cent. above that of the previous year. Plans are now being prepared for a large addition to the factory at Aurora, Ill.

The board of directors of the Joseph Dixon Crucible Company, Jersey City, N. J., has made the following changes in the officers and board of directors on account of the death of Vice-president William H. Corbin: George E. Long, former treasurer, has been made vice-president to succeed Mr. Corbin; J. H. Schermerhorn, former assistant secretary and assistant treasurer, has been elected to membership in the board of directors, and has been made treasurer. Albert Norris has been elected to the office of assistant secretary and assistant treasurer.

Reginald M. Campbell has been appointed to a position in the sales department of the National India Rubber Company, with headquarters in New York. Mr. Campbell was for six years in the electric street railway and lighting department of the Western Electric Company, Chicago. For the next five years he acted as district sales agent for the Ohio Brass Company in the New York and New England territories. Later he was made eastern sales manager for the Peter Smith Heater Company, Detroit, Mich., with offices in New York. His time now will be devoted to the sale of bare and insulated wires and cables for all types of electrical equipment.

Among the railroads that have recently given repeat orders for the Street locomotive stoker are the Norfolk & Western, Chesapeake & Ohio, and the Baltimore & Ohio. The Norfolk & Western has 15 Mallet locomotives in service equipped with this stoker and 25 more of the same type have been ordered. The Chesapeake & Ohio has had 30 Mikado locomotives using this stoker in service since the month of June and will receive 25 additional engines in November. The Baltimore & Ohio uses these stokers on five large Mallets and 20 more are being equipped as fast as they go through the shops. This road will also have this stoker applied to 50 Mikados being built by the Baldwin Locomotive Works, 20 of which have been received. The Hocking Valley will also use this stoker on five Mikado engines which will be received during November.

At the annual meeting of the stockholders of the Carbon Steel Company, New York, the following board of directors was elected for the ensuing year: Charles McKnight, Gilbert G. Thorne, Edward C. Hoyt, George S. Macrum, Edward F. Slayback, D. E. Corbett and Thomas Patterson. At a meeting of the board of directors the following officers were elected: President, Charles McKnight; vice-president, Gilbert G. Thorne; second vice-president, George S. Macrum; treasurer, James Thorne; and secretary, D. E. Corbett. The company is spending approximately $100,000 on its works at Pittsburgh, Pa. The capacity of the forge shops has been increased, and a new 500-ton forging press has been installed. The stockholders have authorized a $2,000 000 bond issue to take care of the present bonded indebtedness and to furnish additional working capital. A sufficient amount of the bonds has been underwritten to provide for all present needs.

CATALOGS

BROWNHOIST BUCKETS AND TUBS.—Catalog E of the Brown Hoisting Machinery Company, Cleveland, Ohio, describes a large and varied line of grab buckets and various kinds of tubs designed and manufactured by it. It contains 56 pages, and is fully illustrated.

LATHES.—Catalog No. 42 from the South Bend Machine Tool Company, South Bend., Ind., contains 35 pages devoted to illustrations and descriptions of screw cutting engine lathes which are shown in a number of sizes. A description of the detail parts is included.

CASE HARDENING STEEL.—A book of useful information and practical rules on case hardening, pack hardening and annealing of steel was issued some time ago by the Ideal Case Hardening Compound Company, United States Rubber building, New York. This work proved so popular that the fourth revised edition is now being sent out.

HYDRAULIC ACCUMULATORS.—In catalog 84, the Watson-Stillman Company, 50 Church street, New York, gives fully illustrated descriptions of the seven principle types of hydraulic accumulators which it manufactures. A few pages are devoted to accumulator accessories and to special hydraulic testing apparatus, reservoirs, etc.

PIPE THREADING MACHINERY.—The Landis Machine Company, Waynesboro, Pa., is issuing catalog No. 20, in which its well known rotary automatic threading die head is shown as adapted for pipe and nipple threading. In addition, a manually operated, stationary die head for pipe work that has recently been developed, is fully described.

CRANES AND HOISTS.—Pneumatic hoists, hand power traveling cranes and jib cranes in various types and capacities are well illustrated and described in leaflets being issued by the Vulcan Engineering Sales Company, Fisher building, Chicago. Each of the various designs is briefly described, and the purpose to which it is particularly adapted is specified.

CRANES AND FOUNDRY EQUIPMENT.—Catalog 99 from the Whiting Foundry Equipment Company, Harvey, Ill., furnishes, in a condensed form, descriptions and illustrations of cranes and other foundry equipment. This equipment is shown in a large variety of sizes and designs suitable for gray iron, brass, car wheel, pipe, steel and malleable iron foundries.

MOTORS AND GENERATORS.—Bulletin 155 from the Crocker-Wheeler Company, Ampere, N. J., thoroughly discusses the design of induction motors for operating on 60 cycle alternating current. It contains twenty pages. Bulletin 156 from the same company is devoted to the subject of the motor-generating sets for all purposes and shows various sizes and arrangements.

PNEUMATIC RAMMERS.—Pneumatic rammers for use in foundries are a comparatively recent innovation, but their simple construction and advantages are rapidly bringing them into general use. Bulletin 121 from the Chicago Pneumatic Tool Company, Fisher Building, Chicago, illustrates and describes several sizes and designs of rammers, as well as two types of pneumatic sand sifters.

CARS AND TRUCKS.—A 92-page cloth bound book issued by the McGuire-Cummins Manufacturing Company, 400 North Sangamon street, Chicago, illustrates a large number of cars that have been built by it for various electric railways. Cars of all classes are shown, each is briefly described, and a table of general dimensions is given. This company has also constructed freight equipment suitable for use in ordinary trunk line service

BOLT HEADING MACHINE.—The maintenance of alinement of the heading and gripping slides on a bolt header or flanging machine plays a very important part in determining the quality and quantity of the product. National Header Talk No. 3, issued by the National Machinery Company, Tiffin, Ohio, is devoted to a discussion of the adjusting liner system on the National wedge grip header. This feature is fully illustrated and described.

COLD METAL SAWING MACHINES.—A cold metal saw, with a capacity for 6 in. rounds and squares, or 10 in. I-beams, is fully illustrated and described in a leaflet being issued by the Vulcan Engineering Sales Company, Fisher building Chicago. It is of the periphery drive type, having a friction type feeding mechanism which can be adjusted while the machine is in operation. It is very powerful, and carries an 18 in. diameter saw blade.

SWITCHBOARD PANELS.—Bulletin 4996, from the General Electric Company, Schenectady, N. Y., is devoted to alternating current switchboard panels with oil switches on a pipe framework back of the panels. These are for three phase, three wire, 240, 480, and 600 volt, 25 to 60 cycle circuits. The panels are fully illustrated and described and wiring diagrams are included. The bulletin contains 44 pages. A similar bulletin, No. 4995, describes direct current switchboards, for double polarity, 125, 250 and 600 volt circuits.

MECHANICAL DRAFT.—The various methods of applying fans to stationary boilers with the purpose of producing artificial draft are fully covered in a booklet issued by the American Blower Company, Detroit, Mich., which is designated as Publication No. 343. A discussion of the principles of combustion and of the different ways of creating draft are included, and a portion of the book is given up to the consideration of the relative advantages of induced and forced draft. A number of illustrations of both systems are shown.

TUBE EXPANDERS.—Hand and power driven boiler tube expanders, in a variety of styles and sizes are thoroughly illustrated and described in Bulletin No. 20, issued by Gustav Wiedeke & Company, Dayton, Ohio. The design of these expanders is based on an extensive experience confined exclusively to this field, and the catalog indicates that all reasonable requirements for locomotive use have been fulfilled. This company also furnishes sectional expanders, as well as the roller type to which this catalog is devoted.

LOCOMOTIVE CRANES.—A handsomely illustrated 63-page catalog is being issued by the Ohio Locomotive Crane Company, Bucyrus, Ohio. The illustrations include a full collection of the details of the equipment used on the standard type of cranes, as well as many views of different types of locomotive cranes at work. This company devotes its attention exclusively to this class of equipment, and is prepared to furnish cranes of various types from 5 to 50 tons capacity, operated by either compressed air, steam or electricity.

LOCOMOTIVE CRANES AT GARY.—Forty-two locomotive cranes were purchased from the Industrial Works of Bay City, Mich., for use in the construction of the United States Steel Corporation plant, at Gary, Ind. These have been used for many different purposes and have been in operation from the beginning of the excavation to the present time. Some of the work that they have performed is shown in a series of 28 photographs, bound in book form, now being issued by the Industrial Works. The pictures are reproduced in sepia and the book is most attractive.

FOSTER SUPERHEATERS.—The Foster patent superheater consists of a series of single loop pipes connecting two headers, each pipe being formed by a seamless drawn steel tube on the outside of which is fitted a series of cast iron annular gills or flanges placed close together. On the inside of each straight section is an inner tube, sealed at both ends, which forces the steam against the heating surface. These superheaters are for

stationary boilers and are fully illustrated and described in a catalog issued by the Power Specialty Company, 111 Broadway, New York.

Freight and Package Handling Machinery.—A 27-page catalog, designated as Bulletin No. 74, and issued by the Jeffrey Manufacturing Company, Columbus, Ohio, contains 134 illustrations of mechanical equipment designed especially for the economical transfer of various materials. In each case the equipment is shown in operation and practically every condition of local transportation is represented. Among the new apparatus of this kind, shown therein, is an improved type of finger tray elevator for raising and lowering packages, boxes and barrels, and a swinging tray elevator platform.

Burning Fuel Oil.—As the use of fuel oil in place of coal continues to increase, interest in burners and other apparatus for handling and transferring this fuel becomes more active. The advantages of oil fuel are well known, and wherever the cost will permit, it is being exclusively employed for both stationery and locomotive boilers, as well as furnaces. A large, fully illustrated catalog from Tate-Jones & Company, Empire building, Pittsburgh, Pa., shows burners of various sizes and designs, as well as pumps and other appliances required in connection with the use of fuel oil.

Roller Bearings for Cars.—Roller bearings for car journals have been used on some railways for ten years, and a catalog recently issued by the Standard Roller Bearing Company,, Philadelphia, Pa., designated as Bulletin 26, shows the financial returns which have been made possible through this medium alone. These bearings are now quite extensively used on light rolling stock, and the development indicates that there will soon be possibilities for similar applications on standard railway cars. The catalog includes sectional drawings of a number of designs, as well as a large number of photographs of car journal boxes and trucks.

Gasolene Electric Generating Sets.—The use of electricity for private lighting and power purposes has been heretofore largely restricted to districts having a central power station. The improvement of both the gasolene engine and the small electric generator has now reached a point where electric generating sets that are easy and inexpensive to operate and are thoroughly reliable can be obtained in practically any desired size. Catalog 205 from the B. F. Sturtevant Company, Hyde Park, Mass., illustrates several sizes of direct connected sets for this purpose. It also gives fully illustrated descriptions of all the details of the apparatus, and includes dimensioned diagrams.

Reversing Motor Planer Drive.—Several years ago the Triumph Electric Company, Cincinnati, Ohio, recognizing the demand for a direct connected electric planer drive, began a series of experiments with the view of developing a design that would fill all requirements. Early in this work it was found necessary to build special motors to suit both the planer and controller, and many interesting inventions have been embodied in final arrangement, for which patents are now pending. This equipment has successfully met severe service demands for the past two years and is fully illustrated and described in Bulletin 501. Curves showing the speed of the platen at various points of the cycle, as well as the current consumption, are included.

Insulation of Railway Equipment.—The Union Fibre Company, Great Northern building, Chicago, is issuing a pamphlet containing 109 pages, which fully discusses the construction of refrigerator cars. It includes a brief history of the development of insulation for this purpose and discusses at some length the theory of insulation. The process of manufacturing Linofelt is described, illustrations of the different processes in the manufacture being freely used. Recommendations as to the proper method of installing insulation on the cars are given and photographs of cars in different stages of construction are used as a demonstration. Tests of refrigerator cars under various normal, as well as very difficult, conditions are included, and a chapter is devoted to steel passenger car insulation.

Ingot Iron.—In 1904 the United States Department of Agriculture made a thorough investigation as to the causes of the rapid corrosion of steel fence wire. The results of this research were published in Bulletin 239, which suggested that the impurities in steel, especially manganese, was the chief cause. Following this suggestion, the American Rolling Mill Company, Middletown, Ohio, started a comprehensive research to devise a means of manufacturing iron free from impurities. The result of this work was the production of a metal called American Ingot iron. An attractively illustrated pamphlet of 44 pages is now being issued by this company, in which the statements of scientists, engineers and users, that have appeared either in the technical press or before various engineering societies, as well as in correspondence, are republished. The illustrations show the uses to which this rust resisting material is now being adapted and photographs of the mills where it is manufactured.

Lubricators and Attachments.—The latest catalog of the Detroit Lubricator Company, Detroit, Mich., contains 232 pages and covers lubricators for practically all purposes, including both the gravity and force feed types, and also illustrates a most comprehensive line of lubricator attachments. The section devoted to locomotive lubricators illustrates new designs which are proving capable of fulfilling the different requirements of the modern large superheater locomotives. They are shown in various sizes, having from two to eight feeds, and a capacity of from two to ten pints. Each is fitted with an oil control valve which allows the feeds to the cylinders being shut off without interfering with the feeds to the air pump and without disturbing the setting of the feed regulating valves. Special lubricators for air cylinders of air pumps are shown in several different sizes. A device which has proved most valuable on large superheater locomotives assigned to long runs has been designed by this company and is illustrated in this book. It consists of a tank with a capacity of about three pints so arranged that the oil can be transferred from it to the lubricator at will. In the back part of the catalog will be found a complete numbered list with prices of all repair parts for all different types of lubricators. The catalog is fully indexed and the illustrations are particularly clear.

Storage Battery Cars.—On September 24, 1912, the first electric storage battery train ever operated, ran from the Pennsylvania station, New York City, to Long Beach, Long Island. It was made up of three Beach-Edison battery cars, carrying one hundred and thirty-six passengers, and maintained the schedule of the Long Island express trains from New York to Long Beach and return. For the round trip of 49.2 miles, which was made at an average speed of 27.4 miles an hour, the power consumption was 622 ampere hours at an average voltage of 220. The maximum speed was 42 miles an hour and a speed of 17.8 miles an hour was maintained on a 2 per cent. grade, two miles in length. The cars in the train were built by the Federal Storage Battery Company, Silver Lake, N. J., for the United Railways of Havana. Each car is 38 ft. in length and is equipped with 220 cells of Edison nickel-steel alkaline batteries, which are carried under the transverse seats. Each car is driven by four ten horse power, series-wound motors. A full description of these cars, as well as of a number of other cars which this company has in service in various parts of the country, will be found in a recent catalog designated as Bulletin No. 31. Full data on the cost of operation, power consumption and other technical features including the charging of batteries, etc., are given.